The BANANA

THE BANANA

Its History, Cultivation, and Place among Staple Foods

R. Ames
1927
MUSA CAVENDISHII
MUSA SAPIENTUM
GROS MICHEL & OVER 100 VARIETIES
ABOUT 40 OTHER
MUSA GLAUCA
SPECIES
MUSA FEHI
SEVERAL VARIETIES
MUSA ACUMINATA
MUSA PARADISIACA
PLANTAIN VARIETIES
MUSA TEXTILIS
MANILA HEMP & OTHER VARIETIES
MUSA BASJOO
SOUTHERN JAPAN. TEXTILE USE
EUMUSA
MUSA MACULATA
MUSA COCCINEA
MUSA ENSETE
MUSA GILLETII
RHODOCHLAMYS (11)
PHYSOCAULIS (10)
(2) HELICONIA
(4) STRELITZIA
(2) RAVENALA
(2) ORCHIDANTHA
GENUS MUSA
MUSOIDEAE
BANANAS
STRELITZIOIDEAE
LOWIOIDEAE
(1) LOWIA
FAMILY MUSACEAE
ARROW-ROOTS
CANNAS
GINGERS
ORDER SCITAMINEAE
MONOCOTYLEDONS
ORCHIDS AND LILIES
PALMS, GRASSES
ETC.

THE BANANA

Its History, Cultivation and Place among Staple Foods

BY

PHILIP KEEP REYNOLDS

WITH ILLUSTRATIONS

THE PROVIDENCE ATHENÆUM

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THIS BOOK
IS DEDICATED TO THE PIONEERS
OF THE BANANA INDUSTRY

INTRODUCTORY NOTE

THOUGH of ancient origin, the banana has become a staple food of modern times. Tracing its history through the centuries is fascinating for there is interwoven much of legend and romance. Probably few of the millions who to-day enjoy this remarkable food fruit know of its colorful and varied history, or realize the wide range of human endeavor involved in its cultivation and in its long but rapid journey from the tropical plantation to the consumer's table.

A constantly growing interest in the subject has led to the publication of this book, which embraces the species, history, and cultivation of the banana and its distribution in North America and Europe. Throughout the volume the author has avoided so far as possible technical language and statistics.

The description of tropical operations (Chapter V) has been partly taken from a paper, written by Mr. George P. Chittenden, Vice President of the United Fruit Company, which appeared in *Fruit Dispatch*, June, 1919.

The account of the distribution of banana cargoes (Chapter VII) is based principally on the practice of the Fruit Dispatch Company, selling subsidiary of the United Fruit Company in the United States and Canada.

Following Chapter II, and with the exception of the brief description in Chapter IV of the Cavendish

banana industry in the Canary Islands, the variety of banana dealt with throughout the book is the Gros Michel, the principal banana of commerce.

In the extensive bibliography are included the books and articles referred to in the text, as well as other works of value. For convenience, titles are classified under three broad heads: General; History and Botany; Chemistry and Food Value.

The author desires to express his appreciation to Professor Oakes Ames, of the Department of Botany, Harvard University, for contributing to and editing the chapter on Botanical Relations, and to Blanche Ames for the frontispiece, presenting the family tree of Musaceæ; to Dr. Herbert J. Spinden, of the Peabody Museum, Harvard University, for references on the early history of the banana, and for data on ancient civilizations; to the New York Times Company for permission to use certain material of Dr. Spinden's published by it concerning the Mayan Empire; to various members of the United Fruit Company organization for their interest and helpful suggestions; to Skinner, Sherman and Esselen, Inc., consulting chemists, and to the several physicians and dietitians who reviewed the chapter on Food Value; and to Mr. John G. Curtis for assistance in matters of editorial detail.

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ERRATA

Page 8, footnote: *For* Perry, Edward W. *read* Berry, Edward W.

Page 40: *For* W. L. Pathbun *read* W. L. Rathbun.

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THE BANANA

CHAPTER I

BOTANICAL RELATIONS

THE banana is worthy of high rank among those plant products which have had a powerful influence in shaping the destiny of mankind. Very early in the development of tropical agriculture, the banana became a staple food plant, and shortly after the dawn of civilization was cultivated over an extensive area in the tropics of the Eastern Hemisphere. High food value, a prolific yield of nutritious fruit, and adaptability to a wide range of conditions admit the banana to that outstanding group of plants on the cultivation of which the foundations of civilization were built.

Just as wheat and barley have played their part in more temperate regions, so the banana has played its part in the tropics. Just as Indian corn, at the time of the discovery of the New World, had been spread by cultivation over an area extending from the Argentine to the Saint Lawrence valley, so even before the time of written history, the edible banana had been spread in the Old World, through cultivation and other human agency, from southern Asia

westward to Africa and eastward to the islands of the Pacific.

The story of the banana begins in the impenetrable mists of the past. We know only a fraction of this story, but what we know of it indicates quite clearly that the edible banana was won from Nature by primitive man, probably in some part of southern Asia, and then carried down through the ages by continuous cultivation.

It may be futile to indulge in speculations about the beginnings of cultivation, but it is probable that the banana was one of the first food plants to receive attention in the early stages of primitive agriculture. Botanical evidence indicates that several species of the banana group were involved and that some of these constituted an important food crop, their stems and buds having first been used. It is, indeed, not improbable that the banana was a source of human food long before the purposeful cultivation of plants prepared the way for agriculture.

Origin of the Seedless Banana

The cultivated varieties of the edible banana do not usually produce fertile seeds. Primitive tribes in southern Asia and the Philippines, however, still use as food some bananas with many hard seeds and scanty pulp. The development of the edible banana from the seed-bearing varieties of scant or no food value and its propagation from underground stems probably occurred during man's struggle against famine in the early stages of civilization.

The development of fruit in plants is a process which cannot be referred to the same causal factors in all cases. Normally it is associated with the growth of the seed, but it may, as in the seedless banana, be connected with other phenomena. To explain parthenocarpy (the condition when a fruit forms without producing seed), several theories have been advanced, but they are too technical for discussion here. Let it suffice to say that hybridization (the intercrossing between species or varieties) is often characterized by the simultaneous appearance of a large number of new forms, some of them extraordinary. A parthenocarpic or seedless fruit might have appeared quite suddenly, more than once, among the progeny of intercrossed species or varieties of Musa.

Some agency to inhibit the growth of seeds and at the same time increase the pulp was essential in the development of the edible fruit-banana. As an effective agent in bringing about this condition, sterility caused by hybridization may be mentioned. It is indeed probable that all the edible bananas are the result of hybridization among different wild forms, some of which may now be extinct.

The importance of hybridization in the production of garden varieties and improved races is too well known to need emphasis, and may indicate equal importance in natural evolution. The large number of varieties of the edible banana (forms of *Musa sapientum*, *Musa paradisiaca*, and *Musa Cavendishii*) is a further indication of hybridity.

Fawcett,[1] in his book on the banana, offers this speculation:

> The fruit does not produce seed in the cultivated varieties. . . . As to the origin of seedless varieties of fruit, there are several species of Musa of which the fruit has no pulp, but consists merely of the outer shell and large seeds filling up the shell like a pea-pod and its seeds, the peas: other varieties have a small amount of pulp. . . . Primitive man, whose food was precarious, was always keen in the matter of selecting food-plants and preserving varieties that were promising, and no doubt took care of the suckers of a banana which yielded pulpy fruit, just as the Arabs grow suckers from date palms that are known to bear good fruit. The selection would be continuous, and whenever a variation occurred with a larger amount of pulp and a corresponding fewness of seeds, it would be carefully treasured and the suckers planted instead of those with little pulp and many seeds. There is no difficulty whatever in understanding how the seedless banana has arrived, nor in understanding how varieties of the seedless type have occurred and been propagated from time to time.

This origin of the seedless banana has also been accepted by several other writers. These writers assume that primitive man, solely through conscious selection from wild or cultivated plants, preserving those forms best adapted to his needs and taking advantage of slight variations in the right direction, developed the seedless banana to its present condition. It seems much more probable, however, that

[1] Fawcett, William: *The Banana: Its Cultivation, Distribution and Commercial Uses* (London, Duckworth, 2d ed., 1921), pp. 15–16.

natural hybridization opened the way for the appearance of a seedless banana, and that with uncanny capacity to recognize useful characters in his food plants, primitive man took advantage of forms with seedless or parthenocarpic fruits and preserved them by vegetative propagation.

Botanical Ancestry

Before we begin the economic history of the banana, we should consider its ancestry as botanical investigation has revealed it, because in no other way are we able to visualize the evolutionary position of the banana in the realm of economic plants. And surely it is worth while to know something about the ancestry of a product that has taken such a prominent part in human history.

The botanical position of the banana and its relation to closely allied plants may be indicated by a schematic presentation, comparable to a genealogical tree (see Frontispiece). The banana and its allies constitute a botanical *family*, known scientifically as the *Family Musaceæ*. A glance at the 'genealogical tree,' based on the Engler and Prantl system of botanical classification, will make clear that the Musaceæ consist of several subfamilies.[1] These are the Musoideæ, Strelitzioideæ, and Lowioideæ (the Lowioideæ being sometimes regarded as a distinct family), each of which takes its name, in a modified form,

[1] The numbers enclosed within circles in the genealogical tree (see Frontispiece) indicate approximately the number of species in each genus.

from a genus or secondary group. The name Strelitzioideæ, for example, is a modification of the generic name Strelitzia. From the Musoideæ, the banana group or genus Musa takes its origin and comprises three subgenera; Physocaulis, Rhodochlamys, and Eumusa. To the last-named subgenus the edible bananas of commerce belong.

When we attempt to trace the botanical source of the banana family, we find that it arises as the lowermost branch of a large and extraordinarily interesting group or *order* of plants, known as the Scitamineæ. On the higher branches of this *order* (these branches being omitted in the genealogical tree) the arrow-roots (starch-yielding plants), ginger-yielding plants, and the well-known Cannas of our gardens are situated. The Scitamineæ are an offshoot of that great botanical group to which the grasses, palms, lilies, and orchids belong. This group is known as the Monocotyledons and, from an evolutionary point of view, constitutes one of the most highly organized concepts of the vegetable kingdom.

The succession of species of Musa, represented by leaves of the large banana plant in the family tree (see Frontispiece), is not intended to indicate botanical affinity; that is, the species are not arranged in an ascending sequence based on increasing complexity of floral structure. With the exception of *Musa glauca*, the species named have been selected on account of their economic importance and those with commercial fruit have been placed at and near the top of the schematic drawing. It might have

been more in accord with botanical thought if *Musa sapientum*, the edible banana of commerce, had been included as a subspecies of *Musa paradisiaca*, but there is certainly an economic difference between these cultivated bananas, a difference which, for practical purposes, warrants their separation and independent treatment.

Geographical Distribution

The geographical origin of the existing genera of the Musaceæ will repay careful study. The genera Musa, Strelitzia, Lowia, and Orchidantha are localized in the tropics of the Old World, and when found elsewhere may be regarded as introduced by the agency of man or by fortuitous circumstances. Ravenala, the Travellers' Palm, which is really a very distant relative of the true palms, is represented by two distinct species, one a native of Madagascar and the other of South America. Ravenala is interesting from the point of view of geographical botany because it is the only genus of the existing Musaceæ which has a representative in both hemispheres. Of the remaining genera, only Heliconia with its twenty-nine species is of American origin and distribution. Lowia and Orchidantha are from Malacca and the four species of Strelitzia are confined to Africa.

Some authorities have inclined to the belief that the banana was originally a native of America. They have relied, in part, for confirmation of this belief on fossils discovered in the early Eocene of the Rocky

Mountain region. These fossils, thought to be the remains of an extinct American banana, were assigned to Musophyllum, a genus originally described to receive a banana-like fossil discovered in Java. The presence of a fossil banana in America has been taken as substantial evidence of the former widespread distribution of Musa and as convincing proof of the probability of independent development, in prehistoric times, of edible bananas in America and Asia. Recent studies of the Rocky Mountain fossil (*Musophyllum complicatum*) have indicated that its forms are referable not to Musa but to the genus Heliconia or to the Canna family. Therefore it would seem that Musophyllum does not furnish sound evidence on which to rely in attributing an American origin to the banana.

Fossil seeds from the Tertiary strata of Colombia have been adduced as additional proof of a New World origin of the genus Musa.[1] These seeds were discovered in coal beds of the Cerros de Guadelupe and Montserrat near Bogota. In size and appearance they resemble closely the seeds of the African *Musa Ensete*, and if they should prove to be truly musaceous, would indicate for *Musa enseteformis*, the fossil species which bore them, a position in the subgenus Physocaulis (see Frontispiece). Even so, we still lack convincing proof that bananas with edible fruit existed in the American tropics prior to the arrival of Europeans. If *Musa enseteformis*

[1] Perry, Edward W.: 'Tertiary of Colombia,' *American Journal of Science*, series 5, vol. 10 (1925), pp. 530–37.

RAVENALA, OR TRAVELLER'S PALM

MUSA ENSETE

MUSA GLAUCA

TREE AND FRUIT
Upper: Gros Michel. Lower: Cavendish

and other species of its alliance grew in America in prehistoric times and were utilized for food, it is indeed remarkable that not a single species of this alliance has persisted as an element of the present flora of South America, or was saved from extinction by cultivation. It is highly probable that when human migrations from the Old World began, there was no living species of edible Musa in South America. If this assumption is justified, then the American species of Musa never became economically important, and we are forced to conclude that fruit-bananas (seedless forms of the subgenus Eumusa) were imported by Europeans from the tropics of the Old World. In connection with this discussion it will be helpful to study the position of the subgenera Physocaulis and Eumusa as shown by the genealogical tree (see Frontispiece) and to bear in mind that no known species of Physocaulis has given rise to an edible fruit with seedless pulp.

Noteworthy Species

Since in the following pages attention is to be given only to the edible species of the subgenus Eumusa, a few remarks about the subgenera Physocaulis and Rhodochlamys may be helpful at this point. The best-known species of Physocaulis is *Musa Ensete*. It is a native of Africa and was first made known to Europeans by James Bruce, who saw the plant in Abyssinia when, between 1768 and 1773, he was seeking the source of the Nile. Bruce described the fruit as being inedible, but he was the

first one to direct attention to the use of the nutritious properties of the central part of the stem (or false trunk) and to describe the manner in which the natives prepared the plant for food. To Bruce we owe the suggestion that *Musa Ensete* was the banana which was utilized as a motif in Egyptian art.[1] *Musa Ensete* is now grown in gardens as a decorative plant, but its economic importance is negligible. Werth,[2] who has recently given attention to the history of the banana group, is of the opinion that no edible fruit-banana has been developed from *Musa Ensete* or from any other species indigenous to Africa.

The subgenus Rhodochlamys comprises about eleven species. The inflorescence is characterized by brilliantly colored bracts, and the structure of the flowers indicates that the species are more highly organized than those of Physocaulis or Eumusa. The species are chiefly Asiatic in distribution. None of them is economically important. *Musa coccinea*, one of the best-known species of the group was originally discovered in China and in 1791 plants were introduced to cultivation. *Musa maculata*, another interesting representative of Rhodochlamys, is of doubtful geographic origin. It was first noticed in Bourbon and Mauritius where the fruit, of little value, is known as *figue mignonne*.

[1] Bruce, James: *Select Specimens of Natural History Collected in Travels to Discover the Source of the Nile in Egypt, Arabia, Abyssinia and Nubia* (Edinburgh, J. Ruthven, 1790), vol. 5, pp. 36–41.

[2] Werth, E.: 'Concerning the Natural History and History of Culture of the Banana,' *Festschrift Eduard Hahn zum LX Geburtstag* (Stuttgart, 1917), pp. 22–58.

The leaf sheaths yield a fibre of secondary and local importance.

In the group *Eumusa*, which includes the edible bananas of commerce, the most important species are: (*a*) *Musa sapientum* (Fruit of the Wise Men) so named because of an ancient legend that the sages of India reposed in its shade and refreshed themselves with its fruit; (*b*) *Musa Cavendishii* (Cavendish, dwarf, Chinese, or Canary variety), found in the Canary Islands, on the African mainland, in parts of the American tropics, in the islands of the Pacific and Indian Oceans, and in the portions of southern Asia where it is truly native; (*c*) *Musa paradisiaca* (Fruit of Paradise), which derives its name from a legend that the tree flourished in the Garden of Eden where its fruit was the source of the knowledge of good and evil; (*d*) *Musa Fehi*, which is common in the forests of Tahiti; and (*e*) *Musa acuminata*, found in Java, the Malay Archipelago, and New Guinea.

Musa sapientum and *Musa Cavendishii* include practically all the bananas of commerce.

Musa paradisiaca: To this species belong most of the plantains,[1] or cooking-bananas. They grow luxuriantly throughout the moist tropical regions of the Old and New Worlds. The fruit is not palatable when raw, but after being cooked becomes an excellent food.

Musa Fehi is the species of plantain best known in many of the islands of the Pacific.

[1] Not to be confused with the 'wild plantain' (Heliconia), which has similar leaves but no edible fruit. (See Frontispiece.)

Musa acuminata is of more than ordinary interest. Kurz [1] is our authority for the statement that a large proportion of the bananas cultivated in the Malayan region has been derived from it. The fruit is remarkable for its quality and delicacy. The best-known cultivated varieties of *Musa acuminata* are the Crab or Copper plantain and the Duck plantain.

Unfortunately, in early literature the banana and the plantain are not clearly distinguished. In appearance they are very similar. In both the plantain and the banana the plant-stalk or false trunk dies after bearing a single 'stem' of fruit. This fruit is usually devoid of seeds and reproduction is by new shoots which arise from the rootstock.

Many varieties of the banana and plantain are ascribed either to *Musa sapientum* or to *Musa paradisiaca*, according to distinctions that depend on the nature of the fruit. If the fruit is palatable when raw, the plant which bears it is referred to *Musa sapientum;* if the fruit must be cooked to become palatable, then the plant is referred to *Musa paradisiaca*.

Plantains are a staple food of all people in hot, moist countries. and in some tropical regions are used as a substitute for potatoes and bread. They are never eaten raw, but are cooked in various ways. The green fruit, rich in starch, with a hard, dry flesh, is sliced and toasted, boiled, baked, or fried as a vegetable or used for making soup and gruel.

[1] Cf. *Kew Bulletin* (1894), p. 245.

TREE AND FRUIT

Upper: Plantain. Lower: Manila Hemp (its fruit is inedible)

RED BANANA, LADY FINGER BANANA, GREEN STEM MAIDEN PLANTAIN, BURRO OR CHAMALUCO PLANTAIN, MANZANA BANANA, INDIO PLANTAIN (LEFT TO RIGHT); GREEN STEM HORSE PLANTAIN (BELOW)

Nourishing and appetizing in all forms, plantains will doubtless be in greater demand in the temperate zones as they become better known.

There is in addition a number of species of *Musa*, some of which bear inedible fruit which resembles the banana. *Musa textilis* (Manila hemp), and *Musa basjoo* grown in southern Japan for its fibre used in coarse fabrics, are examples.

Varieties of Commerce

It is not known what variety of edible banana Father Tomás de Berlanga brought, in 1516, from the Canary Islands across the Atlantic to Santo Domingo. Doubtless other varieties came with later missionaries and explorers. The records show that for more than three centuries banana cultivation spread with the settlement and development of the islands of the Caribbean and the mainland of tropical America.

At the end of that long period, about 1836, came the exploitation, as the result of accidental notice, of the variety of *Musa sapientum* destined to become the banana of a world-wide commerce. This is the Gros Michel, preëminent in the banana industry of to-day. Its commercial advent is thus recorded:[1]

> *The Jamaica banana* — This is the standard commercial banana, and is known also by the names 'Gros Michel' and 'Martinique.' It was introduced into Jamaica about 1836 by Jean François Pouyat,

[1] *Bulletin* no. 4, vol. 1 (Department of Agriculture, Jamaica, 1911).

a French botanist and chemist who settled in Jamaica in 1820. He possessed a coffee property, 'Belle Air,' in Saint Andrew, and on his return from a visit to Martinique planted this banana on his estate. At first known as the 'Banana-Pouyat,' it gradually became known as the 'Martinique Banana,' and now, when the planter in Jamaica speaks of 'banana,' he means this variety, and this alone. The Agricultural Society of the time, on receipt of the first bunch of this banana grown by Mr. Pouyat, awarded him a doubloon [1] for introducing so valuable a variety into the island. From this one plant have grown the millions of bananas that are now cultivated in Jamaica, while the commercial plantations of Central America and of Cuba are, we believe, of the same origin.

The leadership of the Gros Michel in the commercial world is due to the compactness of the bunch, its fitness for transportation, its superior qualities in ripening, and its excellent flavor.

One of the most important banana varieties in the Malay States and the Dutch East Indies, in the opinion of Europeans living in those countries, is *Pisang ambon*, also known as *Pisang medji*. (*Pisang* is the Malay word for the banana and the plantain.) Dr. Otto A. Reinking, who has just returned from an extensive trip to the Far East, where he made for the United Fruit Company a complete study of the many varieties of the banana found growing there, believes that *Pisang ambon*, or *Pisang medji*, as described by Rumpf, known also as Rumphius

[1] The value of a doubloon was then 18*s.* 3*d.*, at modern exchange less than five dollars. This award was doubtless intended more as an honorarium than as a financial recompense.

(1627–1702), Governor of Amboyna, and author of 'Herbarium Amboinense,'[1] is identical with the Gros Michel.[2]

Another variety of *Musa sapientum* (var. *rubra*), contrasting in color with the beautiful yellow of the ripe Gros Michel, is the Claret or Red banana found in the Orient, Central America, and the West Indies. It is known also as Baracoa, Red Jamaica, and Red Spanish. In comparison with the Gros Michel, the bunch is smaller and the fruit itself is shorter but larger in diameter. Although the Red banana has a pleasant flavor, there is not a great demand for it and consequently it is not extensively exported. It is of interest to note that there is a yellow variety of the Red banana, the Silver Skin, which is identical except in color. This variety is easily distinguished from the other yellow bananas.

One of the most popular bananas in the tropics is known in the English-speaking countries as the Apple banana, and among the Spanish as *Manzana;* when reference is made to the plant, the name is spelled *Manzano.* (Teodoro refers this to *Musa sapientum* var. *cubensis.*) The fruit is much smaller than the Gros Michel, only from three to four inches in length and with a very thin skin. It has a slightly acidulous taste, somewhat suggestive of a mellow apple. It is difficult to transport and for this reason is not found in Northern markets.

[1] Six volumes, folio, Amsterdam, 1741–50.

[2] Statement made to the author by Dr. Reinking, who further stated that it was his intention at some future date to contribute to the literature on this subject.

Occasionally the Lady Finger, sometimes called Golden Early or Date banana (var. *champa*), reaches the Northern markets. This is a very small fruit, the fingers averaging only three inches in length. It is thin-skinned and very sweet in contrast to the acidulous flavor of the Apple banana and is considered a delicacy in countries where bananas are grown. It is sometimes called the Fig banana, but this name is also applied, in some localities, to the Gros Michel and Cavendish.

Second in commercial importance is *Musa Cavendishii*. The origin of its name is an interesting story. According to Fawcett, one Charles Telfair was the first to obtain plants of this species from its native country, southern China, in 1826, for his collection of bananas in Mauritius; he considered it the most valuable specimen in his extensive collection. In 1829 Telfair sent to England two of these plants to his friend Barclay, of Burryhill. On the death of the latter, one of these two plants was purchased by the Duke of Devonshire, and produced flowers in his private gardens at Chatsworth. At this time, 1836, A. B. Lambert exhibited at a meeting of the Linnæan Society a copy of an old Chinese drawing which he believed referred to the same species, and named it *Musa Cavendishii* (Cavendish being the family name of the Duke of Devonshire). In the 'Magazine of Botany' for 1837, Paxton, associated with the private gardens of the Duke of Devonshire, gives a colored plate and a description of this plant, and adopts the name given by Lambert. John

Williams, a missionary, brought offshoots of this plant from Chatsworth to Samoa in 1838, and two years later the Reverend George Pritchard carried it from Samoa to the Friendly Islands and Fiji. According to Seemann [1] its introduction to these Islands put a stop to the occasional famines which previously were experienced there.

The bunch and individual fruits of the Cavendish are about equal in size to those of the Gros Michel, but are produced from a much smaller plant. Owing to its dwarf character the plant is preferable to the tall Gros Michel for growing in exposed, windy places. Thus in the Canary Islands the Cavendish, which is largely grown on the mountain-sides, is the banana cultivated and exported.

According to Hillebrand,[2] the Cavendish was introduced into the Hawaiian Islands from Tahiti about the year 1855. The small banana industry in the Hawaiian Islands is based on this variety.

The Cavendish is also cultivated in the Fiji Islands, Queensland, Natal, and Egypt. This banana is more difficult to transport without bruising than the Gros Michel and is usually shipped in some form of wrapping or padding.

Of the plantains, chiefly the fruit of *Musa paradisiaca*, the common yellow variety is to a limited extent an article of commerce and is shipped from Cuba and Honduras to New Orleans and Florida

[1] Seemann, B.: *Flora Vitiensis* (London, Reeve, 1865–73), pp. 288–89.
[2] Hillebrand, W. F.: *Flora of the Hawaiian Islands* (New York, London and Heidelberg, 1888), p. 433.

ports. Also, certain quantities are exported from Venezuela to Trinidad. The fruit is long and thick, averaging eight or ten inches in length, with only fifteen to thirty 'fingers' on the stalk.

There is a short variety of *Musa paradisiaca* common in local tropical markets, but seldom exported. This is the Apple plantain, known in Porto Rico as the Chamaluco, in Cuba as the Burro, in Jamaica as the Whitehall plantain, and elsewhere under various other names.

Search is being made constantly for varieties of the banana superior to the Gros Michel in flavor, as well as in shipping and keeping qualities, but so far nothing has been found equal to it. It is of interest to note that the most complete experimental banana farm in the world is that maintained by the United Fruit Company in its Panama Division. Here are grown about one hundred varieties received from various parts of the tropical world, particularly the Far East.

CHAPTER II

EARLY HISTORY

First Home

As previously stated, the first home of the edible banana was, in all probability, the humid tropical region of southern Asia, where several interesting civilizations were developed. This region includes northeastern India, Burma, Cambodia, and parts of southern China, as well as the large islands of Sumatra, Java, Borneo, the Philippines, and Formosa. Here the seedless varieties of the true domestic banana are even to-day commonly found growing semi-wild, although they may merely have escaped from cultivation. There are also numerous other species of *Musa*, with or without seeds, distributed over this wide territory. The ancient times of the first cultivation are too remote for definite statement.

Border conquests and pressure of population due to the exhaustion of the soil in the ancient regions of civilization were the probable causes for the great migrations of South-Asiatic peoples eastward over the islands of the Pacific. It is difficult to date these migrations, which seem, however, to have been stretched out over many centuries; the earliest, according to the consensus of scientists, was about the time of Christ. By these migrations bananas, with other products of agriculture, were undoubtedly car-

ried far into the Pacific; the earliest explorers found them cultivated in Hawaii and in Easter Island, the latter being a dot of land nearly two thousand miles distant from the nearest other human habitation. Says Seemann:[1]

> A great many different kinds of *Musa* were established in different parts of tropical Polynesia, when Europeans first became familiar with them. In Tahiti alone, Banks and Solander saw twenty-eight. . . . Bananas and plantains are known in Fiji by the collective name of 'Vudi.'

Earliest Historical References

The first clear references to the banana are found in Greek, Roman, and Arabian authors. Alphonse de Candolle, in his 'Origin of Cultivated Plants,'[2] says:

> The antiquity and wild character of the banana in Asia are incontestable facts. There are several Sanskrit names. The Greeks, Latins, and Arabs have mentioned it as a remarkable Indian fruit tree. Pliny speaks of it distinctly. . . . There is an immense number of varieties of the banana in the south of Asia, both on the islands and on the continent; the cultivation of these varieties dates in India, in China, and in the Archipelago from an epoch impossible to realize; it even spread formerly into the islands of the Pacific and to the west coast of Africa; lastly, the varieties bore distinct names in the most separate Asiatic languages, such as Chinese, Sanskrit, and Malay. All this indicated great antiquity of culture, consequently a primitive existence in Asia, and a diffusion

[1] Seemann, B.: *op. cit.*
[2] (New York, Appleton, 1885), pp. 306–07.

contemporary with or even anterior to that of human races.

In the Koran [1] the banana plant is referred to as the paradise tree.

Popenoe [2] states:

> There seems little reason to doubt that the banana was one of the first foods of man, and that it was one of the first plants cultivated.

Beccari [3] sees the banana as a cultivated plant in times too distant to name.

According to Werth,[4] 'The absence of seeds in the cultivated banana is uniformly considered by all writers evidence of very ancient cultivation.'

References to the banana can be found in the Sacred Books of the East, which are generally based upon ancient sources. The banana tree is pictured in early Buddhist art. It is sacred to one of the forms of the Goddess Kali and is especially worshipped on the third day of the month Sravana.[5]

It is likely that the ancient literature of China contains interesting references to the banana, for

[1] Kasimirski: *Le Koran* [*Les Livres sacrés de l'Orient*] (Paris, G. Pauthier, 1840), p. 718. See also Schack, Graf A. F., and Baumgartner, A.: *Geschichte der Weltliteratur*, vol. 1 (1901), p. 364.

[2] Popenoe, Paul: 'Origin of the Banana,' *Journal of Heredity*, vol. 5 (1914), p. 273.

[3] Beccari, Odoardo: *Wanderings in the Great Forest of Borneo: Travels and Researches of a Naturalist in Sarawak:* tr. by Dr. Enrico H. Giglioli (London, Constable, 1904), pt. 5, Musa.

[4] Werth, E.: *op. cit.*

[5] Birdwood, George C. M.: *The Industrial Arts of India*, 2 vols. [*Art Handbooks*] (South Kensington Museum), vol. 1 (1895), pp. 87–88.

the Chinese at a very remote time were advanced in agricultural science.[1]

Some writers have argued that certain sculptures in Assyria and Egypt picture the banana or plantain, albeit in a manner far from realistic.[2] If these sculptures are taken to represent the Asiatic fruit-banana, there is some justification for skepticism. It must not be overlooked, however, that the native African banana, *Musa Ensete*, might have furnished their motif.

We know from the writings of Pliny that the Greeks under Alexander were much impressed by

[1] According to the *Great Chinese Encyclopedia*, vol. 149, there are twelve different species of banana growing in China: Pa Chü, Kan Chiao, Ya Chiao, Pa Chiao, Pan Chiao, Tien Chü, Chi Chiao, Hung Chiao, Mei Jên chiao, Fo Shou chiao, Yang chio chiao, Niu fu chiao. Most of these bananas are described as grown in the Provinces of Kwantung, Fukien, Kwangsi, and Hainan. They vary in appearance as follows: One kind has fruit shaped like goat-horns, seven to eight inches long, with interior of white-yellowish color and sweet taste; another has still longer fruit which is described as square-shaped, but not as sweet tasting; still another has oval-shaped fruit with interior of milk-white color and of very sweet flavor. It is also stated in this source that other plants of the banana family grow in nearly all parts of China, which yield no fruit and are described as even lacking blossoms.

The *Great Chinese Encyclopedia* is a stupendous work conceived by Emperor K'ang Hsi (1662–1723) of the Manchu Dynasty, who selected a famous scholar named Ch'en Meng-lei for the post of chief compiler with four thousand other scholars. The work was finished A.D. 1726 and was printed from types cut (not cast) in copper. The British Museum possesses what is probably the only complete copy of this edition to be found outside of China. (This note is by courtesy of the Gest Chinese Research Library, McGill University, Montreal.)

[2] Drawings reproduced in Rung, R.: 'Die Bananenkultur,' in *Petermann's Mitteilungen*, Supplementary no. 169 (Gotha, 1911), pp. 1–117.

this fruit after they had crossed the Indus in their conquest of India in 327 B.C.

The Rôle of the Arabs

Some writers assert that the name *Musa* comes to us from the Arabs, among whom both the banana and plantain are called *mûz*, and that perhaps this term is derived from a still earlier Sanskrit word. Another explanation is that the name was given to the banana group by Linnæus in honor of Antonius Musa, physician to Octavius Augustus, first Emperor of Rome, 63–14 B.C. The Arabs, having obtained the fruit in India, probably introduced it into the Holy Land and northern Egypt, where it seems to have been unknown before the Mohammedan conquest (650 A.D.).

One of the earliest Arabic references to the banana is found in verses of Masudi, a poet who died in 956 A.D. He extols a dish called *kataif*, an old Arabian delicacy popular in Damascus, Constantinople, and Cairo, which was a confection of almonds, honey, and bananas swimming in nut oil.

Various Arabic authors wrote on the medicinal and food properties of bananas. Says Garcia de Orta, the famous Portuguese physician and botanist, who went from Portugal to India and spent the rest of his life in the East:[1]

> The Arabs call them Musa, and both Avicenna and Serapian devote a chapter to them calling them

[1] *Colloquies on the Simples and Drugs of India* (London, Sotheran, 1913). This is a translation of the Lisbon edition of 1895, the original having been published in the late Sixteenth Century, in Latin.

by the same name, as does Rasis . . . so that it is clear that these writers were acquainted with the fruit. If this is not enough, ask any Arab what he calls Amusa or Musay, whether he be from Cairo or Damascus or Jerusalem.

Africa

Peter Martyr, sent as Ambassador from Spain to Venice and Egypt in 1501, and the author of letters of great historic value, tells of plantains as a common food in Alexandria at the end of the Fifteenth Century, 'where they are called Musa.'

Nearly two and a half centuries later, Disraeli wrote from this land of fruits to his sister Sarah in England, in a letter dated at Cairo, May 28, 1831:[1]

> Oh the delicious fruits that we have here and in Syria! Orange gardens miles in extent, citrons, limes, pomegranates; but the most delicious thing in the world is a banana, which is richer than a pine-apple.

As regards East Africa, and more especially Madagascar, there is the added problem of the introduction of the edible banana direct from Indonesia, which may or may not have been earlier than the first Arab trade. This is indicated by the presence in this region of the taro, breadfruit, and other fruits not found in Arabia. Commerce between India and the east coast of Africa flourished

[1] Monypenny, W. F., and Buckle, G. E.: *The Life of Benjamin Disraeli, Earl of Beaconsfield* (New York, Macmillan, 1920), vol. 1, p. 176.

in the first thousand years of the Christian era. Zanzibar and Mozambique were centres of Arab and East India trade long before the discovery of America. The Hovas of Madagascar are a people related to the Javanese. It is not surprising, therefore, that useful food plants were transported to these coasts and that the edible banana and the plantain have been in use in Africa for many centuries.

The Arabs were instrumental in distributing the fruit across the continent. Not only did they exert a strong influence on the peoples of the Guinea Coast by reason of their settlements in Morocco and the Soudan, but they engaged in ivory and slave trade across Central Africa, which is good banana territory. The banana was gradually carried westward by the native tribes and with the plantain was well established in West Africa when the Portuguese first explored the Guinea coast in the years 1469 to 1474.[1]

The Name Banana

Von Diedrich Westermann, one of the principal authorities on African languages, states that the word 'banana' is undoubtedly of West African origin, being found in various forms along the Gulf

[1] By 1469 the Portuguese had reached Sierra Leone. 'In this year King Affonso V of Portugal contracted with Fernao Gomez to discover one hundred leagues of coast every year, starting from Serra Leoa (Sierra Leone). In January, 1471, some of the men employed by Gomez had reached Sa Jorge de Mina and on the fifth year of the contract, 1474, Ruy de Sequeira arrived at Cape Sa. Catherina 2° 3′ lat. S.' Roth, H. Ling: *Great Benin: Its Customs, Art and Horrors* (Halifax, England, King, 1903), p. 4.

of Guinea; from the languages of this region he cites: *banema, banama, benena.*[1]

Sir Harry Johnston, in his scientific comparison of the Bantu group of languages,[2] gives many distinct names for the banana, such as *konji, dom, baku, tori, nika*, etc. But the root of our modern word banana is also found in languages extending from Sierra Leone and Liberia westward along the Guinea Coast. He says:

> '*Bana, banana,*' is a widespread word in the Guinea Coast regions and it was here that the west European word originated, through the Portuguese.
>
> Some original forms of the word banana are: *Banna* — the Balum tribe of western Sierra Leone; *Banā* — the Padebu of eastern Liberia; *Bana* — the Vai of southwestern Liberia; *Gbana* — the Gora of western Liberia; *Abana* — the Temne and Baga of South Guinea; *Funana* — the Fulup and Fonyi of North Guinea; *Banane* — the Konyagi of Upper Gambia.

The plantain has long been in use in Liberia while the banana is of recent introduction. According to Sir Harry Johnston no wild indigenous species of Musa has been reported there. He states:

> Although the climate ought to be well suited to its growth, the banana does not take an important place as a staple food in Liberia. In all probability, as no form of the edible banana is really indigenous to Africa, it has scarcely penetrated as a cultivated plant into all the recesses of the Liberian forests.

[1] *Anthropos*, vol. 8 (1913), p. 811.

[2] *A Comparative Study of the Bantu and Semi-Bantu Languages* (Oxford, 1919), pp. 996–97.

Garcia de Orta,[1] after giving the East Indian names of the fruit, writes of their further occurrence: 'in that part of Africa named Guinea, where they are called bananas (also bonana and bonano).' His book was published in 1563, but Garcia de Orta was along the African coast only once and that was in 1534. He says he knew the banana before going to India and was struck by the fine flavor of those of Sofala in Mozambique. Pigafetta, who published in 1591 the original descriptions of the Guinea Coast by Lopez,[2] says:

> A great quantity of fruit is found there, named 'banana,' by the natives, which I believe to be the same as the *Musa* of Alexandria which it resembles both in form and flavor.

The name 'banana' came into rather general use, perhaps because the Portuguese as great navigators carried this and other economic plants around the world. We find the name in the Moluccas, one of their first colonies, which Purchas visited. Writing of Amboyna, he says:[3] 'Amboyna bringeth forth Oranges, . . . Coquos, Bananas and other fruits.'

As collateral evidence that the word 'banana' came from the Guinea Coast of Africa, there is a considerable use throughout Latin America of the name 'Guineo' for one or more kinds of the fruit.

[1] *Op. cit.*

[2] Pigafetta, Filippo: *A Report on the Kingdom of Congo and of the Surrounding Countries, from the Writings of Duarte Lopez* (Rome, 1591). Translated by Margarete Hutchinson (London, Murray, 1881), p. 68.

[3] Samuel Purchas: *Purchas His Pilgrimage* (1613), vol. 1, p. 452.

Migration to the Canary Islands

The Portuguese also carried the banana to the Canary Islands. The aboriginal population of these islands had long been out of touch with the mainland when they were rediscovered about 1341. The conquest began in 1402 and at this time the banana was quite unknown and barley was the staple food.[1] But according to Leopold von Buch [2] the banana was introduced to these islands along with negro slaves from Guinea.

This was a notable and interesting stage in the westward journey, not only in view of the present importance of the Canary Islands in banana culture, but also because here, according to unquestioned historic evidence, is the point of departure of the banana for the New World.

Introduction of the Banana to the New World

For a long time the origin of the edible banana in the New World was regarded as doubtful as that of the American Indian.

Alexander von Humboldt is largely responsible for the idea that there had been a pre-Columbian spreading of the banana to America. In this he was mistaken. Humboldt based his belief on two early passages, one found in Acosta's 'Natural History,' published in 1590, and the other in the 'Royal Commentaries of the Incas,' by Garcilaso de la

[1] Hooton, Ernest A.: *The Ancient Inhabitants of the Canary Islands* [*Harvard African Studies*, vol. VII] (Cambridge, University Museum, 1925), p. 69.

[2] *Physikalische Beschreibung der Kanarischen Inseln* (Berlin, 1825).

Vega, published in 1609. Alphonse de Candolle, in a discussion of these authorities in his 'Botanical Geography' and his 'Origin of Cultivated Plants,' shows that the statement by Acosta was wrongly interpreted by Humboldt.[1] Also, an examination of Garcilaso de la Vega's text shows that in all probability his remarks on the banana slipped into manuscript in the wrong place. He had announced his intention to distinguish the plants known to the ancient Indians from those brought in by the Spaniards. For the indigenous plants Garcilaso gives native names and uses, but for the banana he gives no such information. Indeed, a survey of the languages of America shows an overwhelming use of Old World terms for the fruit, more or less modified to be sure, in Indian speech.

Referring to Garcilaso's contention that the plantain was among the plants cultivated in Peru previous to the arrival of the Spaniards, Ernst [2] states:

> But carefully studied, his words prove little: in the first place he does not mention any name of the plantain in the Quichua language (a thing that he did not omit in the case of the other plants cited), and moreover he constantly used the present form in his account, as one talking not of the past but of the present. . . . We believe therefore that Garcilaso

[1] In *Science*, vol. 61, no. 1589 (June 12, 1925), 'Origin of the Banana,' Dr. W. E. Safford, of the United States Bureau of Plant Industry, calls attention to the harm done by Humboldt and denies that any evidence of the banana or plantain in America has been found. Dr. Safford states that the first home of both fruits was in southern Asia, especially the islands of Indonesia.

[2] Ernst, A.: *El Zulia Ilustrado*, vol. 1, no. 30 (Maracaibo, Venezuela, April 30, 1891), p. 241.

has committed an error in citing the plantain among the plants of the Incas, an error probably due in part to the eminently tropical aspect of the plant especially in comparison with the other plants introduced by the Spaniards.

Prescott[1] states that bananas grew in Peru, and in a footnote there is a reference to Humboldt and the statement that the banana leaf had frequently been found in Peruvian tombs. This has been repeated by various botanists, but it seems to rest upon a mistaken identification of the leaf. Heinrich Harms, in his authoritative 'Study on the Remains of Plants in Peruvian Tombs,'[2] dismisses the banana and the plantain from ancient America. Also, as has been said, very ancient remains of Musa-like plants have been recovered in deposits of Tertiary Age in regions at present untropical; for example, on the high plains of Bogota in Colombia and in Yellowstone Park, but there is no evidence that any of these plants bore edible fruit.

Hans Stade during his captivity among the native Indians of eastern Brazil (1547–55) found no bananas in use there.

Jean de Lery,[3] who followed shortly after Hans Stade, but who was in the Portuguese settlements instead of among the wild Indians, gives a detailed description of the banana as a new and remarkable

[1] *History of the Conquest of Peru* (London, Allen & Unwin, 1886), Book 1, chap. 4, p. 67.

[2] In *Festschrift Eduard Seler* (Stuttgart, 1922), p. 166.

[3] Lery, Jean de: *Histoire d'un Voyage fait en la terre du Bresil autrement dite Amerique* (La Rochelle, Antoine Chuppin, 1578), pp. 205–06.

American fruit which the Indians in their language called *paco*, *bago*, and *bacove*.

L. C. van Panhuys [1] states that Lery was mistaken and that the names are from the Portuguese, '*bago*' meaning 'fruit in a bunch.' Van Panhuys quotes from the Encyclopædia for the Netherlands' West Indies:[2] 'It seems that bacove is a Tupi word.' He then points out that the Encyclopædia is in error. In correction he states:

> To say: the Arawack name of a fowl is *kallina* would cause a similar confusion; it is a Spanish word accepted by the Arawacks. There seem to us to be strong arguments in favor of the thesis that the word 'pacova' was brought over, together with the fruit itself, by the Portuguese from Africa.

On the other hand, the report of the introduction of the banana to the New World, following Columbus, is definite and complete. Oviedo,[3] after visiting the West Indies and Central America, wrote the first natural history of the New World. He expressly states that Friar Tomás de Berlanga brought a fruit, which is obviously the true banana, from the

[1] 'Observations on the Name Bacove,' in *XXI International Congress of Americanists* (Göteborg, 1925), pp. 321–32.

[2] *Encyclopaedie van Nederlandsch West-Indie* (1914–17).

[3] Oviedo y Valdés, Gonzales Fernandez de, Spanish historian, born at Madrid, in August, 1478. Educated at the Court of Ferdinand and Isabella. In his thirteenth year became page to their son and was present at the siege of Granada and there saw Columbus previous to his voyage to America. On the death of Prince John (1497), Oviedo went to Italy, and there acted as Secretary to Gonzales Fernandez de Cordoba. In 1514 appointed supervisor of gold smeltings at San Domingo and on his return to Spain was appointed historiographer of the Indies. He paid five more visits to America before his death at Valladolid in 1557.

Canary Islands to Santo Domingo, in 1516.[1] He begins:

> There is a fruit here which is called 'Platanos' . . . nor did they use to be in the Indies but were brought hither. . . . One hears on all sides that this special kind was brought from the Island of Gran Canaria in the year 1516 by the Reverend Father Friar Tomás de Berlanga of the Order of Predicadores, to this city of Santo Domingo whence they spread to the other settlements of this island and to all other islands peopled by Christians. And they have even been carried to the mainland and in every part they have flourished. . . . The first ones were brought, as has been said, from Gran Canaria, and I saw them there in the very monastery of San Francisco in the year 1520. Also they are in the other Fortunate or Canary Islands and I have heard say that they are found in the city of Almeria in the kingdom of Granada. They say that this plant was passed thence to the Indies and that to Almeria it came from Levant and from Alexandria and East India.

Oviedo, in his concluding references to Berlanga, states:

> He was appointed Bishop of Castilla del Oro en la Tierra-Firme (Panama) because he is in truth a very religious person and of great example, and such an honor well befits him, because his doctrine has been very beneficial in these parts for things referring to

[1] Oviedo y Valdés, Gonzales Fernandez de: *Historia general y natural de las Indias, Islas y Tierra-Firme del Mar Oceano*, 4 vols. (Madrid 1851–55), vol. 1, pp. 290–93.

Oviedo's first work was published in Toledo in 1526. A second edition was issued in Seville in 1535. There has been no English translation of Oviedo's general history, although one is now being prepared by the Cortez Society. The translation here given was made by Dr. H. J. Spinden.

the service of God our Lord, and for such he was selected, he, being modest, never having requested or solicited the honor.

In the long and varied history of the banana there is no more dramatic picture than that of this missionary-pioneer setting out on his long and perilous voyage to the New World and carrying with him the plant whose food value had been proved for centuries. Thus he provided that his work might endure by giving the people of his mission the means to live. The good padre little realized how his foresight pointed the way to those who, centuries later, made their broad plantations contribute so much to the economic support of the American tropics.

Later historians, among them Nordenskiöld,[1] Veth,[2] Ernst, and van Panhuys, regard the statements of Oviedo as authoritative. It is significant that their discussions of the banana relate only to the species or variety brought from 'Gran Canaria.'

Referring to Nordenskiöld, van Panhuys states:

> N. says that Oviedo expressly states that the banana (*M. sapientum?*) was introduced into America in 1516 by brother Thomas de Berlanga, and that, although the banana is not mentioned by the first pioneers, and was evidently not cultivated by the Indians before the whites made them acquainted with it, there was a general impression a few decades later that it was an American plant.

[1] Nordenskiöld, Baron Erland: 'Deductions Suggested by the Geographical Distribution of Some Post-Columbian Words Used by the Indians of S. America' [*Comparative Ethnographical Studies*, 5] (Göteborg, 1922), pp. 64–85.

[2] Veth: *Uit Oost en West, Explanation of some foreign words* (Arnhem, 1889), pp. 242–46.

He then quotes Nordenskiöld's comment:

> It is important to remember that if the banana had really existed in America, it must have been universal. A fruit so easily cultivated, *and so important as an article of food* (italics ours) could never have remained uncommon.

According to the historian Cobo,[1] Sebastian Ramirez de Fuenleal and Vasco de Tuiroga introduced the banana in Mexico in 1531. This statement is of particular interest, indicating as it does the rapid spread of the banana to the mainland from Santo Domingo.

During the Seventeenth and Eighteenth Centuries, references to the cultivation and use of the banana and plantain are found in practically all descriptions of tropical America. The following are typical examples: For Panama a report of 1607[2] says: 'Of the fruits of the land the most important is the platano, in much abundance; it is very nourishing and is eaten raw, boiled, baked and stewed.' In 1640, 'Platanos of Guinea are found — very fine stems, sweet and full of flavor being ripe and in season.'

The celebrated buccaneer and navigator, Dampier, who was an 'under-manager' on an estate in Jamaica in 1674, in his 'New Voyage round the World' (1679–91), speaks of the value of the banana and plantain as food. He gives many methods of

[1] Cobo, P. Bernabé: *Historia del Nuevo Mundo*, vol. 2, p. 444.

[2] *Relaciones historicas y geographicas de America Central* (Madrid, 1908), p. 147.

preparing the banana as food,[1] besides the usual way of eating it as a ripe fruit. Père Labat also mentions various banana recipes in use in the French West Indies over two centuries ago.

The following account by Gumilla[2] is typical, the banana and plantain being considered without distinction:

> They are a very hardy fruit and the most useful of all those that the Indians sow; the plantain is perennial. . . . When green and roasted these serve as bread; in the pot they serve as vegetables. When half ripe and yellow they are good for stews with the bitter-sweet flavor of a half ripe apple. After ripening, the fruit is highly flavored but hearty. Roasted when ripe there is no fruit more healthful in America, nor so substantial, nor so well savoured. Placed in the sun the ripe fruits dry after the manner of the figs of Europe but with much better flavor than figs. Before they are fully dried in the sun the Indians mash them in warm water, and take this gruel when on the point of turning sour, and strain it with warm water into large jars. It then ferments like malt and there results a very strong drink of which a little quantity causes drunkenness. When very ripe plantains are hung over a vessel and allowed to distil, a very strong and wholesome vinegar results from the juice which drops down. In other words the plantains are the relief of all poverty: in America they serve as bread, as meat, as drink, as conserve and everything else, because they satisfy hunger in all these ways. . . . For the sake of abundant aid the

[1] Fawcett, *op. cit.*, p. 108.

[2] Gumilla, J.: *El Orinoco Ilustrado, Historia Natural, Civil, y Geographica, de Este Gran Rio, y de Sus Caudalosas Vertientes* (Madrid, 1741), pp. 471–72. There being no English edition, this translation is by Dr. Spinden.

missionary fathers have made a plan that after the savages have agreed on the place where they will get together to form a colony, the first matter of importance is to make a clearing and to arrange in advance an extensive plantain field for the universal relief of those who are going to settle there.

One of the earliest English writers, Lionel Wafer, says: [1]

On the *Main* also are *Plantains* in great abundance, which have a Body consisting of several leaves or coats, that grow one from under another, spiring upwards into an oblong fruit at the top; the Coats of Leaves, which are very long and large, spreading off from the Body, and making a Plume all round. None of them grow wild, unless when some are brought down the Rivers in the Season of the Rains, and being left aground, sow themselves. The *Indians* set them in Rows or Walks, without underwood; and they make very delightful Groves. They cut them down to get at the Fruit; and the Bodies being green and sappy, they are cut down with one Stroke of an Axe.

The *Bonano's* also grow on the *Isthmus* very plentifully. They are a sort of *Plantain*s. The fruit is short and thick, sweet and mealy. This eats best raw, and the *Plantain* boil'd.

According to Stedman: [2]

Another species resembling this (the plantain) is the banana, which only differs from the plantain

[1] *A New Voyage and Description of the Isthmus of America* (London, 1699), pp. 87–88.

[2] Stedman, Capt. John Gabriel: *Narrative of a Five Years' Expedition against the Revolting Negroes of Surinam in Guiana on the Wild Coast of South America from the year 1772 to 1777* (London, 1796), p. 372.

in its fruit being less and more oval, and this species is never eaten till it is yellow and fully ripe.

No pictures or references to either the banana or plantain have been found in ancient American Indian sources, which supports the general opinion of scientific men that both these species of *Musa* were introduced into America by the Spaniards following the discoveries of Columbus, and were unknown before that time to any of the American Indian tribes. Botanical evidence as well is all in favor of an Old World origin for the edible banana.

The accounts of early conquests in regions where the banana now flourishes show that the Spanish soldiers found none of this fruit, which would have been a welcome addition to their larder. They were gold hunters and their search of these countries was thorough. Benzoni, who was well acquainted with the banana, accompanied the first military expedition to Costa Rica in 1541, where Diego Gutierrez found gold eagles worn as ornaments, but no bananas eaten. Nor does Columbus mention this fruit, although he remained some time near Bocas del Toro.

The impression on the part of many travellers that bananas and plantains were grown in ancient America is probably due to their wide use, and to the fact that they are found in a wild state along the rivers in Central and South America. In these cases the plants were uprooted originally in Spanish settlements at the heads of streams, and drifting down found lodgment on mud banks. Bananas

and plantains were not found by the earliest expeditions.

The interesting studies of the names for the banana used by the Indians of South America recently made by Nordenskiöld,[1] von den Steinen [2] and van Panhuys,[3] who have reviewed the early historical sources, lead to the conclusion that the banana was unknown in South America before the arrival of the Spaniards.

When the banana in its western travels reached the Pacific, its journey around the world was complete. From the Indo-Malayan region, where it was first known, it migrated with man across the Indian Ocean to Africa, through the four thousand miles of the Dark Continent, then on to the Canary Islands and across the Atlantic to the West Indies and Middle America, meeting the lesser eastern migration from southern Asia to the islands of the Pacific.

Man early recognized the food value of the banana as well as the fact that its suckers, even though partly dried and carried long distances, would readily take root and grow in a rich soil and a warm, humid climate. Hence in establishing colonies or missions, in transporting slaves and providing against famine, the banana appears consistently in the historical records of tropical countries of both hemispheres.

[1] *Op. cit.*

[2] Von den Steinen, K.: *Durch Central-Brasilien* (Leipzig, 1886), pp. 310–14.

[3] *Op. cit.*

CHAPTER III

DEVELOPMENT OF THE INDUSTRY

Early Importations to the United States

As late as the middle of the Nineteenth Century travellers and naturalists wrote of the banana as a delicious fruit and a valuable food for the tropics, but for tropical countries only. The portability of the banana, now a familiar fact, was not then realized, and its possibilities, through modern transportation, as a staple food for the peoples of the temperate zones, were not foreseen.

According to a tradition, which apparently first appeared in print in the 'Fruit Trade Journal' (December 20, 1893), the schooner Reynard on a voyage from Cuba in 1804 brought thirty bunches of bananas to New York. At long and irregular intervals thereafter, small consignments of red bananas from Cuba and the Bahama Islands arrived during the spring months on 'pineapple' schooners at Atlantic coast ports. By 1850 clipper schooners were bringing occasional small cargoes from Cuba. One of the earliest firms engaged in these small importations was that of J. and T. Pearsall, later changed to Gomez and Pearsall.

Toward the close of the Civil War small lots of yellow bananas found their way to New Orleans in schooners from the Bay Islands, off Honduras, and were sold by the schooner owners, usually the cap-

tains, along the levees at auction. The first company to bring bananas to New Orleans was the New Orleans and Bay Island Fruit Company, which imported the fruit in schooners about 1870. This concern lasted less than two years.[1]

In 1866, Carl August Franc,[2] a German steward on one of the Pacific Mail steamships, brought a small quantity of yellow bananas from Aspinwall (within the present Panama Canal Zone and at that time a part of Colombia, South America). He realized good prices and made several small shipments. His two brothers then joined him and the firm of Frank Brothers was organized. The planting of bananas gradually assumed considerable proportions at Aspinwall and the firm made regular importations of bananas to New York from that port.

A few years later the three Franc brothers, W. L. Pathbun, a planter and shipper operating in Aspinwall, and Seymour Haight, a small banana importer, formed the corporation of Frank Brothers Company, later changed to Aspinwall Fruit Company.

When the French, in 1881, under de Lesseps, attempted to build a Panama Canal, the high wages paid to labor precluded the planting of bananas. The

[1] In the early nineties the following were the principal banana importers at New Orleans: Hoadley and Company and J. L. Phipps and Company (handling principally the shipments of Minor C. Keith), John Wilson and Company, Macheca Brothers, S. Oteri, Bluefields Banana Company, and J. B. Camors and Company.

[2] This man was usually called 'August,' probably due to the fact that one of his two brothers was named Carl B. When the brothers incorporated their business, they changed the spelling of their last name to 'Frank.'

planters became laborers and the fruit declined in quantity and quality, with the result that shipments of Aspinwall bananas practically ceased.

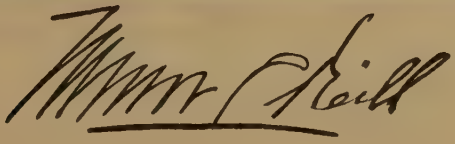
In the light of subsequent events, it is of interest to note that the two real founders of the banana industry — Captain Lorenzo D. Baker and Minor C. Keith — made their first banana ventures within two years of each other, Baker in 1870 and Keith in 1872.

Born in New York and for two years engaged in the cattle business in Texas, Minor C. Keith at the age of twenty-three went to Costa Rica in 1871 and joined his three brothers, who were attempting to construct a railroad from Port Limon to San José. The building of this line was a task to strain men's courage to the breaking-point. The surveys led through fever-haunted country. Supplies were moved up from the coast only after tremendous effort. But despite the decimation of their ranks by disease and hardship, the army of laborers hacked their way through the forest and floundered through the morass, dragging after them the third railway in Central America.[1] The first twenty-five miles cost four thousand lives, mostly of negroes, as the Costa Ricans were too well informed to risk their lives in the fever-laden swamps and jungles.

[1] The first railway constructed in Central America was the Panama Railway, begun in 1850 (in territory then considered in South America), built at the rate of about eight miles a year, and completed in 1855. The second was the Honduras Railway, work on which was begun at Puerto Cortez in October, 1868. Some thirty-eight miles were completed and put in operation a few years later.

Keith lost his three brothers in the attempt. At one time both the whites and the negroes, on account of financial difficulties, worked nine months without pay. They loyally refused, however, to abandon Keith, although he offered them full pay and free return transportation to their homes. It took nineteen years to build the railroad from Port Limon on the Caribbean coast to San José, the capital city, a little over one hundred miles.

Young Keith early saw that even to complete the road he must have freight in paying quantities, and decided to go into the banana business. He obtained a supply of roots and suckers from Carl A. Franc at Aspinwall (now Colon), with which to make his banana experiments in the Costa Rican jungle. While waiting for his plantations to produce, he made an initial shipment of two hundred and fifty bunches from Aspinwall to New Orleans in 1872 on the deck of the S.S. Juan G. Meiggs, the first steamer shipment of bananas to that port. This experiment proved successful and was followed by small regular shipments on this boat. When his Costa Rican plantations commenced to bear, and railway extension permitted, Keith substituted Limon bananas for those from Aspinwall. In 1879 he commenced shipping small cargoes to New York, in joint account with the Atlas Line steamers. These were the first bananas ever received at that port from Costa Rica. Even at that time the fruit was looked upon as a curiosity and a rare tropical luxury; no one dreamed of its later



L. D. Baker

becoming an important factor in the food supply of the United States and Canada.

Keith, during the following twenty-five years, continued his banana shipments to New York by the Atlas Line, and to New Orleans in joint account with J. L. Phipps and Company. He gradually developed his banana business in Central America, drawing his fruit supplies from Costa Rica, Nicaragua, and Honduras, and also from Colombia in the vicinity of Santa Marta. It is an interesting fact that with the exception of Carl A. Franc's early and irregular shipments from Aspinwall, Keith's were the first banana shipments made from any of these countries. The bulk of Keith's bananas were shipped to the New Orleans and New York markets, where he became the biggest factor in the business.

In 1870, the year before Keith went to Costa Rica, Captain Lorenzo D. Baker, of Wellfleet, Cape Cod, owner of the little 85-ton schooner Telegraph, took a charter to convey a party of gold miners with their machinery and supplies to Ciudad Bolivar, Venezuela, some two hundred miles up the Orinoco River. On his return trip he stopped at Port Morant, Jamaica, for a load of bamboo for New York, and also took aboard a small quantity of bananas of the yellow variety. He made a quick voyage and on June 23d 'Came to anchor at Jersey City — Thus ends our passage of 11 days — all well.' [1]

[1] Abstract of the log of the schooner Telegraph. While this log mentions only bamboo as cargo, Mr. L. D. Baker, the son of Captain

After several months of fishing and freighting, Captain Baker set sail from Provincetown on March 21, 1871, in the Telegraph, for Port Antonio, Jamaica, and on arrival there loaded a full cargo of coconuts and bananas, which he brought to Boston and landed in good condition. It is claimed that these were the first bananas ever brought in quantity to this port.

The following abstract of log covering the return voyage from Port Antonio to Boston is of historic interest. On April 6th, the schooner arrived at Port Antonio, West Harbor, in a leaky condition. Several weeks were spent by Captain Baker in caulking his ship and otherwise putting it in shape.

May 8th, 1871	Finished taking in cocoanuts — whole number on board 35,220. Took in 400 bunches bananas
May 9th	Clear and pleasant Took in some bananas
May 10th	Clear and pleasant Took in some fruit
May 11th	At 4 AM Pilot came on board took vessel around to the East Harbor Took in some fruit and at 11 AM got underweigh and proceeded to sea at noon

After a tempestuous voyage the schooner arrived at Boston. Log continues:

May 28th	At 8 PM passed Boston light At 9 PM came to anchor at Quarantine

Baker, has stated to the author that his father frequently told him that he also carried some bananas on this particular voyage.

May 29th At 6 AM got underweigh and came to the City and hauled alongside Long Wharf Pumps duly attended and so ends sea log

As a result of the success of this speculative venture, Baker conceived the idea of operating a fleet of schooners in the banana trade between Jamaica and Boston, and interested another Cape Cod skipper, Captain Jesse H. Freeman, in the scheme. Baker spent a considerable part of his time in Jamaica attending to the supplying and the loading of banana cargoes. Due to the inadequate means of transportation afforded by sailing vessels, the enterprise at the end of three years was unsuccessful, and Baker was forced to go to sea again to replenish his lost savings. Thus we find him in 1874 master of the schooner Ruth N. Atwood, and two years later in command of the schooner Eunice P. Newcomb, both vessels of 109 tons, carrying cargoes of general merchandise to Jamaica and on his return trips bringing bananas to Boston.

At this period schooners made the trip from Jamaica to Boston in the average time of sixteen to seventeen days, an exceedingly good passage being fourteen days. The fruit was cut very 'thin' and on the quicker voyages usually arrived in good condition. When, however, the vessels were delayed by calms and head winds, which often happened, the fruit generally reached port too ripe to bring a profit. The small and irregular cargoes were not sufficient to create a steady demand or a uniform market price.

In these days schooners brought bananas to Northern ports only during the short season of spring and early summer; in the autumn, some were engaged in the fishing trade and during the winter brought oysters from the Chesapeake or were otherwise occupied.

Early in 1876, William Anderson joined the schooner Eunice P. Newcomb as mate, and a few years later became its master. Through the years following, Captain Anderson was master of various schooners and steamers engaged in banana transport for the Boston Fruit Company.[1]

By 1879 Captain Baker had established in Jamaica an organization through which he loaded other vessels as well as his own. He made shipments of Jamaica bananas to Boston and also sent the fruit to New York by the steamships of the Atlas Lines, for which he was agent, and continued doing so for some years. Some of this fruit was forwarded from New York by rail to Boston and disposed of in that market. In the meantime Baker had taken as partner his brother-in-law, E. B. Hopkins, the firm name being L. D. Baker and Company.

The establishment of banana production in Jamaica proved to be the economic salvation of the island, as since the late sixties the sugar industry there had been in severe straits. Captain Baker, in

[1] On account of his valuable experience in this trade, Captain Anderson was made Manager of the Marine Department of the United Fruit Company shortly after its creation. For many years he was an important factor in the development and operation of its extensive fleet, and only in 1925 retired from active service.

SCHOONER JESSE H. FREEMAN, 1883

S.S. BOWDEN, 1889

A. Pasteur

creating the Jamaica banana industry, laid the foundation of the future prosperity of the island — a service which was gratefully recognized by the people of the colony, happily during his lifetime.

From the beginning the fruit shipped by Captain Baker to Boston was sold by the commission house of Seaverns and Company, associated with whom was Andrew W. Preston. The actual sales were made by him and he became convinced that, properly organized, there was a bright future for the banana business. In later years, largely by his own ability in organization, and firm tenacity of purpose, he proved that this conviction was well founded.

Birth of the Boston Fruit Company

Captain Baker was so impressed with Preston's ability in disposing of his fruit shipments that he invited him to join his banana enterprise. As a result, the Boston Fruit Company was organized, in 1885. This was an association of ten New Englanders,[1] including Captain Baker, Captain Freeman, and Andrew W. Preston. Each member contributed a small amount of capital — two thousand dollars. It was agreed to waive dividends and to reinvest in the enterprise all earnings for a period of five years. Before this time limit had been reached, the partners, notwithstanding the fact that in their early

[1] The names of the ten men who formed the partnership, Boston Fruit Company, in 1885, are: Lorenzo Dow Baker, Lamont G. Burnham, John F. Crocker, Edric Eldridge, Jesse H. Freeman, Major Thomas B. Griffith, Thomas Mandell Hart, Isaac N. Keith, Edward D. Mandell, and Andrew W. Preston.

operations their first capital was practically lost, subscribed additional capital of five times the original amount. During the trying days of these early and later years, Preston's courage and ability to command confidence and to arrange finances with the banks, when funds were needed, were large factors in the success of the enterprise.

The decade from 1880 to 1890 was marked by steadily increasing banana importations by various firms to the Atlantic and Gulf ports and by the gradual passing of the schooners, the fruit at the end of that period being transported almost entirely by steamships.

In 1883 the Jesse H. Freeman, the latest and largest of the schooners, of about 500 tons, and with auxiliary steam engines, was bringing to Boston regular cargoes of about 10,000 stems. A similar but larger ship, the Lorenzo D. Baker, continued in the Boston service until 1889.

In 1888 the British steamer Marmion, of about 700 tons, which had been making a few trips under charter for the Boston Fruit Company, was purchased by that Company and brought cargoes of approximately 20,000 stems. She was later named the Bowden. The purchase of this ship, for about $65,000, marked an epoch in the Company's history. Although it represented at that time a tremendous undertaking, it proved a very fortunate investment and the banana cargoes delivered by this steamer netted handsome profits.

In 1890 the enterprise was incorporated, retaining

its first name, with Captain L. D. Baker as President and Andrew W. Preston as the Boston Manager. The Boston Fruit Company gradually extended its operations until, with several subsidiaries, it drew its banana supplies not only from Jamaica but from San Domingo and Cuba, and shipped the fruit to Boston, New York, Philadelphia, and Baltimore. The Bowden was followed by the British ships Ethelred, of 894 tons; Ethelwold, of 956 tons; Barnstable and Brookline, of 1100 tons each; and the Beverly and Belvidere, of 1400 tons each with cargo capacity of about 30,000 stems. These vessels were all built specially for the banana trade under specifications furnished by the Boston Fruit Company, by whom they were operated under long-term charters, and had limited passenger accommodations. In addition the Company operated a number of smaller British and Norwegian vessels.

In 1898, the four 'Admirals,' the Admiral Dewey, the Admiral Sampson, the Admiral Schley, and the Admiral Farragut, of 2100 tons each, were built by William Cramp Sons of Philadelphia for carrying bananas. These vessels had each a capacity of 40,000 stems and accommodations for 53 passengers; they were chartered by the Boston Fruit Company and later by the United Fruit Company, bringing banana cargoes regularly from Jamaica to Boston and Philadelphia.

No history of the banana industry is complete which fails to mention the activities of W. W. Hurlbut and Company, steamship agents and brokers, of

New York. In 1879 this firm chartered the first steamship ever chartered for the West Indian banana trade. Particularly during the period from 1880 to 1900, it was the principal factor in planning and arranging tonnage for the various banana importers. The firm name was later changed to Bennett, Walsh and Company, and is to-day Bennett, Hvoslef and Company.

Need of Stabilization of the Industry

The popularity of the banana grew steadily and toward the end of the Nineteenth Century the number of companies and firms engaged in the banana business at Atlantic and Gulf ports increased, as did the size of the cargoes. The trade, however, was not properly supplied with bananas, as importations were irregular and unreliable, the distribution haphazard, and the quality of the fruit uncertain.

Sales continued to be handled from ship's side, with the result that it was not always possible to dispose of all the fruit. What was left over was, for the most part, consigned to near-by interior cities for disposal on a commission basis. As was to be expected, money was invariably lost when it was necessary to resort to this method of selling.

Difficulties in securing and disposing of bananas made greater organization necessary in every department of the business, which in turn called for greater capital. The tendency of the day was, however, toward reduced expenses of doing business. Obviously there was need for a radical change and

the company taking the lead in the right direction was the one assured of a successful future.

To improve the unsatisfactory merchandising conditions in the Eastern States and the Middle West, a sales organization, the Fruit Dispatch Company, was created by Preston and incorporated in December, 1898. This Company sold the bananas imported by the Boston Fruit Company interests, which fruit otherwise would have been consigned to commission merchants in the interior. Later the Fruit Dispatch Company assumed the distribution of all the bananas shipped to the United States by the United Fruit Company.

Creation of the United Fruit Company

In March, 1899, the United Fruit Company was incorporated through a consolidation of the interests of the Boston Fruit Company, headed by Andrew W. Preston, drawing its supplies for the most part from the West Indies, and of the companies headed by Minor C. Keith, securing their bananas from Central America and Santa Marta, Colombia. This union of forces was imperative to insure an adequate supply of bananas and to establish the industry on a permanent basis.

At the time of the organization of the United Fruit Company the following firms, corporations, and persons were engaged in importing bananas into the United States:

Boston Fruit Company (including subsidiaries whose stock it had previously purchased)

Tropical Trading and Transport Company, Ltd. (Keith interests)
Colombian Land Company, Ltd. (Keith interests)
Snyder Banana Company (Keith interests)
J. D. Hart Company
J. M. Ceballos and Company
Orr and Laubenheimer Company, Ltd.
Camors, McConnell and Company
New Orleans Belize Royal Mail and Central American Steamship Company
W. W. and C. R. Noyes
John E. Kerr and Company
J. H. Seward Importing and Steamship Company
Aspinwall Fruit Company
West Indian Fruit Company
Monumental Trading Company
West India Trading Company
Henry Bayer and Son
Camors-Weinberger Banana Company, Ltd.
J. B. Cefalu and Brother
S. Oteri
The Bluefields Steamship Company, Ltd.
W. L. Rathbun and Company

There were undoubtedly other firms and individuals engaged in the banana business on a small scale, but the above list includes all those of consequence in the trade. The first four were merged into the United Fruit Company.

Prior to 1899, the year of the formation of the United Fruit Company, there had been organized, according to the best available information, not less than one hundred and fourteen companies or firms which engaged in the importation of bananas to the United States.

Most of these banana companies were inadequately financed, and under the management of men who had no practical knowledge of the banana industry. Few had been in business for as long a period as ten years, and most of them handled insignificant quantities of bananas. With monotonous regularity these mushroom banana companies would spring into being, struggle along for a short time, and then drop out of existence, leaving behind no assets for their stockholders.

As a result of the consolidation represented by the United Fruit Company, large production areas in widely separated localities were for the first time brought under a single control, thereby insuring regular supplies of fruit in case of losses by hurricane or flood in any single area; ample capital and resources were made available to insure large-scale operations; new territories in the tropical jungle were opened up and sanitation and preventive medicine employed from the beginning in converting them into extensive banana farms; the interior markets were developed, and a regular demand for bananas throughout the year was created. In the improvement in transportation linking these countries with the Northern markets, the refrigerator steamship has played an important part.

It is in consequence of these developments that the entire business from plantation to jobber is today highly organized and efficient, and that dealers throughout the country are able to get a regular supply of the fruit the year round.

Upon the creation of the United Fruit Company, Andrew W. Preston was elected President, serving in that capacity until his death in September, 1924. During this long period as Chief Executive, Preston's sound business judgment and foresight, backed by his belief in the greater potentialities of the banana industry, were largely responsible for the success of the Company. During the organization period, the coöperation and support of T. Jefferson Coolidge, Jr., President of the Old Colony Trust Company, was of great help to the new company.

Minor C. Keith was elected First Vice-President. With his wealth of tropical experience, coupled with large vision, his services were of inestimable value to the United Fruit Company. Keith retired a few years ago from the Company to devote his energies to railway building in Guatemala and Salvador. To-day, in his eightieth year, he is still active in these tropical enterprises.

Captain Baker, whose speculative schooner deckload of Jamaica bananas figures so prominently in banana history, served the Company ably as its representative in Jamaica and as a Director until his death in 1908. Three years before, on his sixty-fifth birthday, a remarkable tribute was paid him by the citizens of Jamaica. On this occasion he was presented with a silver service and a memorial of his work for the benefit of this British colony. The affectionate regard of the people was expressed among others by His Grace the Archbishop of the West Indies, who stated:

> He has effectively helped others at the same time that he has pressed forward his own enterprises to a successful issue. He is an American, and I am glad that the man who has done so much for this ancient British colony is a worthy representative of that noblest type of American citizen which New England has produced in such great numbers.

In the application of modern methods in the tropical operations of the United Fruit Company, an important part has been played by Victor M. Cutter. Born in Dracut, Massachusetts, Cutter after working his way through and graduating from Dartmouth College in 1904, entered the service of the Company as a timekeeper in Costa Rica. His thoroughness, industry, and progressive ideas won him early and steady promotion. After filling the various positions in the tropics, including that of Manager, he was made General Manager of Tropical Divisions, and then transferred to the General Offices, Boston, as Vice-President in charge of Tropical Divisions. Upon the death of Andrew W. Preston, Cutter, at the age of forty-three, was elected President of the United Fruit Company.

Commercial Introduction of Bananas into Europe

Bananas were first imported commercially into England in small quantities from Madeira in 1878 and from the Canary Islands in 1882, but were regarded as exotic rarities. In 1884 the total importations into England were about ten thousand bunches. In 1892, Arthur H. Stockley and A. Roger

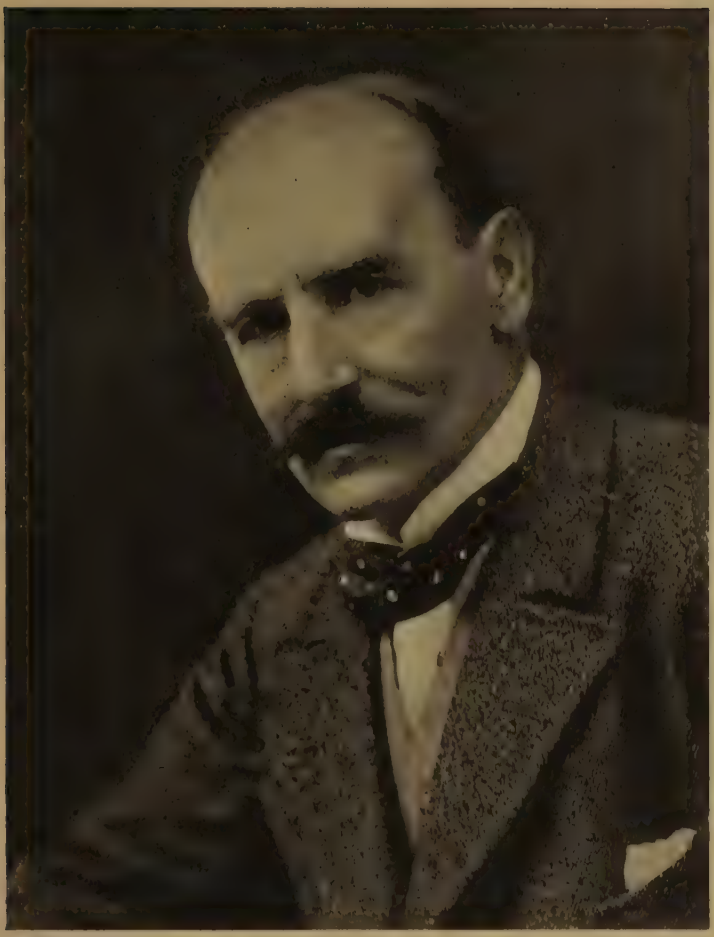
Ackerley, for Elder, Dempster and Company, began importations from the Canary Islands, and about this time Fyffe, Hudson and Company also started to import bananas from these islands. During the next decade the fruit passed from what might be termed the 'luxury stage' to that of an everyday food.

Minor C. Keith, about 1896 or 1897, commenced trial shipments of Costa Rican bananas from New York to Liverpool in the fastest available Atlantic liners of that time. The bunches, with the ends of the stems covered with asphaltum, were packed in dried banana leaves and placed in crates or boxes. One thousand to two thousand bunches were shipped weekly in this manner and the fruit was sold at auction at Covent Garden, London. Some of the fruit arrived in good shape and sold as high as the equivalent of fifteen dollars a bunch, but too often it arrived in spoiled condition. At the end of a three-year period, Keith found that he had lost some $15,000 in the venture and stopped shipments.

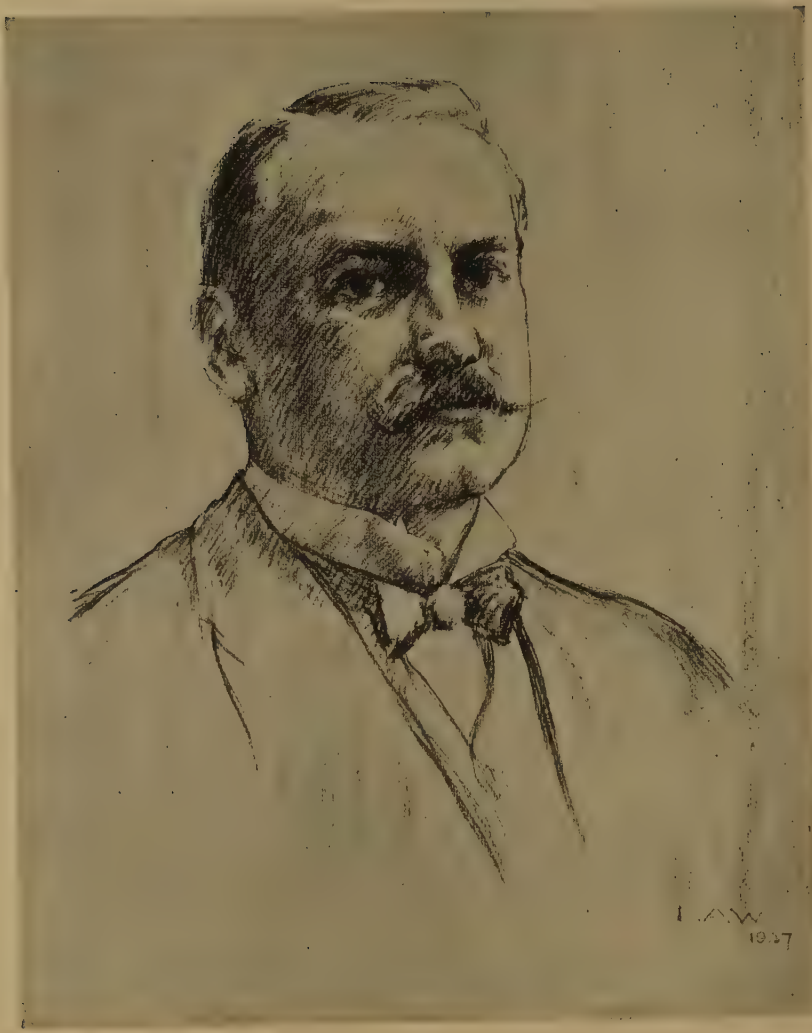
In 1901, the Imperial Direct Line between Bristol and Jamaica was started by Sir Alfred Jones, Chairman of Elder, Dempster and Company, and steamships, especially fitted with refrigerating apparatus, loaded at Jamaica a cargo of about 25,000 bunches once a fortnight.

Creation of Elders and Fyffes, Ltd.

In May, 1901, Elders and Fyffes, Ltd., was incorporated, with Sir Alfred Jones as Chairman. At the



G. H. Stockley



A. Roger Ackerley

start the Company sold and distributed the fruit brought to Bristol from Jamaica in the Elder, Dempster boats. As the British fruit merchants had become accustomed to Canary bananas, imported in nicely made wooden crates, covered with paper, straw, and cotton wool, the advent of the 'naked' banana aroused a great deal of opposition from the fruit trade. This prejudice was overcome by the energy and tact of Arthur H. Stockley and A. Roger Ackerley, of Elders and Fyffes, Ltd. In 1902 that Company became associated with the United Fruit Company, and began to charter and build its own refrigerator tonnage, with the result that regular importations of bananas from Costa Rica, in addition to the supplies from Jamaica, were begun with its own fleet. In 1910 the United Fruit Company became the owner of all the capital stock of Elders and Fyffes, Ltd.

At the outbreak of the World War, in 1914, bananas from the American tropics were being distributed in every European country, as far north as St. Petersburg (Leningrad) and Helsingfors, as far east as Tiflis, and as far south as the Mediterranean. The war and the difficulties following in its train retarded the development of the Continental business. However, the demand later steadily increased in spite of the depreciated currencies. Belgium, France, Holland, Switzerland, Germany, Austria, and the Scandinavian countries are now taking large quantities of the fruit. To-day, the Elders and Fyffes fleet, comprising thirty-one re-

frigerator steamships, many of them equipped for carrying passengers, maintains a regular and direct service between ports in England, Germany, and Holland and ports in the West Indies, Central America, Colombia, and the Canary Islands. Three new ships are being built and will be added to the fleet in 1928. This efficient organization is doing splendid constructive work. The story of its progress is a notable contribution to industrial history.

While those responsible for the creation and development of the industry comprise a long list of names, the following will be remembered in banana history: Friar Tomás de Berlanga, who introduced the banana to the New World; Jean François Pouyat, the discoverer of the Gros Michel, the principal banana of commerce; Carl B. Franc, Captain Lorenzo D. Baker, Minor C. Keith, Andrew W. Preston, and Victor M. Cutter. The outstanding pioneers of the banana trade in Great Britain are Sir Alfred Jones, Arthur H. Stockley, and A. Roger Ackerley, and on the Continent the two last-named gentlemen, who are still active in the business. In recording the foresight, courage, and organization which have made the banana industry what it is today, tribute must be paid to the physicians, engineers, and other faithful workers whose splendid and unselfish efforts through many years have made the American 'banana' tropics a place where men may live and work in health and safety.

CHAPTER IV

HOW AND WHERE THE BANANA GROWS

The Plant

The banana plant, or tree as it is commonly called, is a rapidly growing herbaceous perennial which contains in the aggregate about eighty-five per cent of water. It is probably the largest terrestrial plant not having a woody stem above ground.

The true stem, or rhizome, of the banana is subterranean. From it orginates the 'pseudo-stem,' or, as it is sometimes called, the 'false trunk.' The food stored in this underground stem, as well as that furnished by the leaves, nourishes the flower-stalk and fruit, and also the new shoots.

The banana has no woody roots, nor a taproot as do most trees. From the rhizome or fleshy root-stock arise a mass of cord-like roots, uniform in size and of about the diameter of a lead pencil. Some of these run out laterally, just below the surface of the ground, to a distance of fifteen feet or more; others will penetrate the soil vertically to a depth of several feet. Along the roots occur numerous slender, much-branched rootlets, bearing root-hairs which alone are able to absorb from the soil food materials in solution; similar root-hairs are found upon the main roots, immediately back of the growing tips. Running through the central part of the roots is a system of vascular or vein-like tissues, which act

as conduits for the transmission to the stem and leaves of the water and raw materials taken in by the root-hairs.

On the rhizome large buds or 'eyes' develop, somewhat as on the potato. From these buds the leaves grow upward, the first being tightly rolled and sharply pointed, and appearing above the ground three or four weeks after planting. Growth takes place rapidly, new leaves pushing up through the centre of the pseudo-stem.

What seems to be the trunk of the young tree is in reality only a compact mass of overlapping leaf-sheaths. As the plant develops, the older leaf-sheaths are pushed outward by the young, growing leaves within, and a smooth, shiny, strong pseudo-stem is formed. When fully developed the bright green leaves are from eight to twelve feet long with a breadth of two feet and even more, and spread out or rise almost vertically, giving a very graceful, palm-like aspect to the plant. The number of leaves varies from eight to twenty, according to the soil conditions and the vigor of the plant itself.

These leaves adapt themselves in interesting fashion to sunshine and shade. When the sun's rays are perpendicular and too intense, the blade collapses and the under-surfaces containing the pores contract, thus protecting the plant against too great evaporation. In wet and moderately cool weather, the edges of the blade curve upward, permitting increased evaporation, which is necessary for rapid growth.

CLOSE VIEW OF RHIZOME, OR ROOTSTOCK

A PILE OF 'BITS' READY FOR PLANTING

ROOT SYSTEM (SURROUNDING EARTH REMOVED)

BANANA PLANTS OF THREE, SIX, AND NINE MONTHS (RIGHT TO LEFT)

BANANA PLANTATION

The materials which insure the formation of a bunch of bananas are made in the leaves through the action of sunlight on chlorophyll, the green coloring substance which they contain. This is a purely vegetable product and is so important in the life of plants and, indirectly, is so essential to the life of animals, that it has been referred to as the most decisive organic agent at work on the surface of the earth. Under the influence of light, and only in the light, chlorophyll breaks down or decomposes the water taken in by the roots from the soil and the carbon dioxide received by the leaves from the air, and recombines the chemical constituents of these compounds, in definite proportions, to form sugar. The sugar thus formed is soluble and in solution is translocated to regions of growth where it is used in building up new structures. More sugar may be formed than is needed for immediate use by the plant. When this is the case, the excess sugar is translocated to storage tissues and transformed into starch. In the case of the banana, this starch is stored in the rhizomes and in the fruit.

It should be understood that this process is characteristic of all green plants and is not peculiar to the banana, which, however, offers a striking example of its significance.

Three to four weeks after the rhizome has been planted the first leaf appears above ground, and in the course of about twelve months the 'tree' has reached a height of fifteen to thirty feet, with a diameter at the base of nine to sixteen inches, ac-

cording to climatic and soil conditions. By the tenth or eleventh month, the stem which is to bear the fruit has pushed itself up from the root-stock through the centre of the leaf-sheaths, and the blossom has 'shot,' or appeared in the centre of the crown of the stalk. From three to four months are then required to develop a bunch of bananas ready for cutting, the time again varying considerably with the soil and climate. After emerging at the top of the trunk, the flower-bud increases in size and bends over and downward, looking not unlike a huge ear of corn enveloped in its husk. The bracts then drop off, disclosing the young bananas, quite small and pointing downward; these turn upward as they become larger.

The flowers of the banana plant are produced in clusters, spirally arranged, upon a long stalk.[1] The first few of these clusters which appear (commonly six to twelve, sometimes more) give rise to the future 'hands' of fruit; the later clusters contain sterile flowers incapable of producing fruit. In some varieties these sterile flowers remain on the stalk and merely wither away; in others, notably the Gros Michel, they fall from the stalk, which terminates in a more or less heart-shaped or conical 'navel.' This

[1] The inflorescence is a terminal spike with floral leaves placed spirally, and sometimes magnificently colored; in the axils of each of these, several flowers are situated in two transverse rows (accessory buds); the lowest flowers are pistillate, the upper ones staminate, so that the fruit is found only in the lower region of the inflorescence, the remaining portion persisting as a naked axis after the bracts and flowers have fallen off; the inflorescence terminates in an ovoid bud formed by the flowers that have not opened.

FLOWER-BUD EMERGING FROM TEN-MONTHS-OLD PLANT (LEAVES CUT AWAY)

FLOWER-BUD A FEW DAYS AFTER EMERGING AT TOP OF 'TRUNK' AND BEFORE BRACTS HAVE FALLEN

FLOWER-BUD A FEW DAYS AFTER SOME OF THE BRACTS HAVE FALLEN

YOUNG BUNCH WITH ALL BRACTS OFF, SHOWING FINGERS' START TO TURN UPWARD

TERMINAL FLOWER-BUD (SPATHE) DEVELOPED BELOW THE BUNCH OF BANANAS

This bud (or heart) is composed of maroon-colored bracts and clusters of creamy-white, yellow-tipped male flowers

ovoid bud or 'blossom' consists of maroon-colored bracts tightly enclosing the remaining small, yellowish, male flowers.

Since many eyes are developed on a single rhizome, there eventually arise from it a number of shoots, called 'suckers.' In the course of time each sucker that is allowed to mature develops a rhizome of its own.

Banana plants differ greatly in size. Those growing in the rich river-bottoms along the Atlantic coast of Central America sometimes reach a height of thirty feet. By way of comparison it is of interest to note that the average height of the banana tree in Central America is from eighteen to twenty-five feet, and in Cuba from twelve to fifteen feet, the difference showing clearly the effect of climatic conditions as we recede from the humid warmth of the torrid zone.

The Fruit

Each plant developed to maturity from the rhizome bears but a *single bunch* of bananas, which is made up of so-called 'hands' (clusters), each containing from ten to twenty individual bananas, or 'fingers.' Commercially, bananas are classed as ranging from nine to six hands; any bunch having less than six hands is not readily marketable.[1]

[1] A commercial terminology has grown up, peculiar to the banana business; thus:

'Variety' indicates the country where produced and exported. For example: 'Limons' are grown in the vicinity of Port Limon, Costa Rica; 'Telas' are produced in the vicinity of Tela, Honduras, etc.

A bunch varies in weight according to the variety of the fruit, the number of hands, and the soil and climatic conditions under which it is grown. The average weight of a nine-hand bunch ranges from fifty to sixty-five pounds. A considerable number of bunches have more than nine hands and occasionally a bunch is produced with as many as twenty-two hands with more than three hundred individual bananas. A bunch of this size will weigh one hundred and fifty pounds, but is extremely rare.

The heaviest and best-developed fruit comes from Central America, and the lightest fruit from Cuba, the difference being explained by varying climatic conditions which, as previously noted, affect also the size of the tree itself.

Even when it is to be consumed locally in the tropics, the banana is always green when cut from the tree. If allowed to ripen on the plant, it loses its delicious flavor and becomes insipid; also, the skin bursts open and the ripening pulp becomes the prey of insects.

The necessity for infinite care in handling a bunch

'Stems' is a general term applied to bananas, irrespective of class, and has exactly the same meaning as 'bunches.'

Bananas are divided into classes based on the number of hands, of not less than ten fingers, to the stem; thus, 'Nines' are bunches containing nine or more fully developed hands; 'Eights' are bunches containing eight fully developed hands.

'Grade' refers distinctly to the fulness of the fruit when harvested and is expressed as follows: 'full three-quarter,' the grade of fruit cut for the United States market; and 'three-quarter,' the grade cut for the English and Continental markets. The latter grade represents less fully developed fruit, which is necessary on account of the longer voyage.

TERMINAL FLOWER-BUD USED IN FAR EAST AS A VEGETABLE

BANANA LEAVES AND FIBER USED IN FAR EAST FOR WRAPPING AND TYING

TROPICAL JUNGLE HAS GIVEN WAY TO GREAT BANANA FARMS

BANANAS UNDER IRRIGATION

of bananas will be appreciated when it is realized that this fruit, when harvested, is practically a living organism drawing sustenance from its stalk, with sap flowing and tissues changing; that in the ripening process it generates heat within itself; that a few degrees of temperature above or below normal may stimulate too rapid ripening, or cause checked vitality and chill; and that from the plantation to the ripening room it is shipped without being wrapped or crated.[1]

Where Grown and Exported

Bananas are grown in practically all the moist tropical countries, where they constitute one of the principal foods. While they can be cultivated in sub-tropical zones, their production to the best advantage demands a tropical climate and considerable rainfall. They grow best in fine, sandy loam. Good underdrainage and aëration are essential. In certain districts where the soil is good but the rainfall insufficient, irrigation is practiced. This is pos-

[1] Canary and Hawaiian bananas are exceptions. Canary bananas are packed in strongly made wooden crates — the larger fruit one bunch to a crate, the smaller fruit two, and sometimes three bunches to a crate. The bottom of the crate is first covered with a layer of straw; then the bunch is wrapped in a large sheet of paper and carefully placed in the crate, which is thereupon stuffed with straw. In the last few years, cylindrical leatherboard drums have been used to a considerable extent instead of wooden crates. Hawaiian bananas, which are shipped in small quantities and only to San Francisco, are wrapped first in a layer of soft paper, usually newspapers, then in a padding of rice straw, with finally an outer covering of banana fibre or leaves, the bundle itself being tied securely with a heavy hemp cord. Each bunch is baled separately and the curved end of the stem is allowed to extend through the wrapping to facilitate handling.

sible only where an abundant water supply is available, as the water requirement of the banana is enormous.

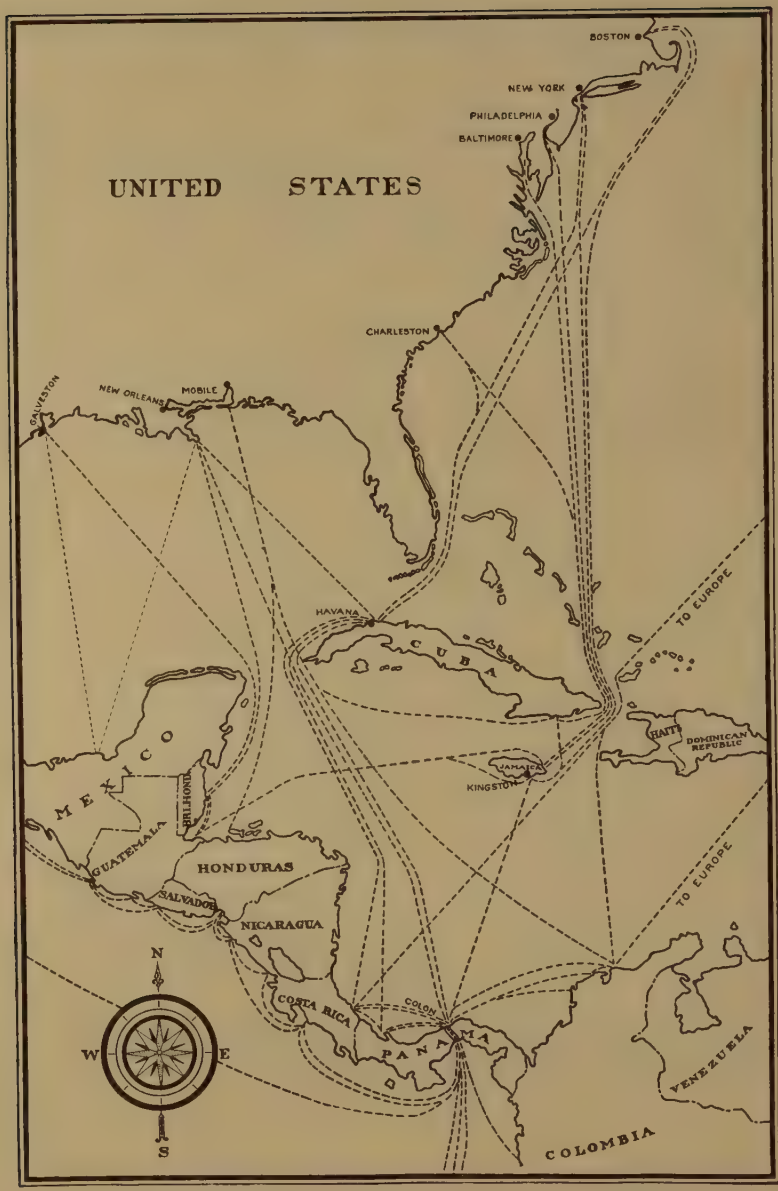
Exports, in bunches, of the principal banana-producing countries, for 1926, were approximately as follows:

Jamaica	18,250,000
Honduras	14,500,000
Colombia	10,870,000
Costa Rica	7,660,000
Canary Islands	7,200,000
Guatemala	5,900,000
Mexico	4,150,000
Panama	4,060,000
Cuba	2,650,000
Nicaragua	2,150,000

The United States and Canada are the world's largest present-day market for bananas, their total consumption for 1926 approximating 53,500,000 bunches, exported from the Caribbean countries. A small quantity, about 250,000 bunches, is shipped to San Francisco from the Hawaiian Islands. Banana imports of Great Britain and Continental Europe now reach 25,000,000 bunches annually and are obtained from the Caribbean countries and the Canary Islands.

In Ecuador, bananas (principally the Gros Michel) are produced and are exported in small quantities from Guayaquil to Peruvian and Chilean ports, as far south as Valparaiso. In Brazil there is a considerable banana production (chiefly of the Cavendish

BANANA PLANTATION IN PRODUCTION



MAP SHOWING AMERICAN BANANA TROPICS, SEA ROUTES, AND IMPORTANT BANANA PORTS OF ENTRY ON NORTH ATLANTIC AND GULF COASTS

and the Apple varieties) in the vicinity of Santos; about one half of the output is exported to Buenos Aires and Montevideo, the remainder being consumed locally in São Paulo and near-by places.

Bananas are produced in Queensland, Australia, from sixty to a hundred miles north of Brisbane, the total production being about 3,500,000 bunches annually. Apart from the local consumption this fruit is marketed principally in Sydney and Melbourne. It is now the general practice on the plantations, after the fruit is harvested, to cut the bunches of green fruit into individual fingers or small hands of three or four bananas each. The fruit is then packed in wooden cases of standard size and is ripened while in the cases. The Fiji Islands export bananas in a small way to New Zealand. Fiji fruit was formerly sent to the Australian market, but shipments were discontinued on account of the heavy import duty.

In addition to exports, there is a tremendous production and local consumption of the banana and its near kin, the plantain, throughout the moist tropical regions of both hemispheres, including the Philippine Islands, Malay Archipelago, Fiji Islands, and the various islands of the Pacific within the torrid zone.

Banana Cultivation in the Canary Islands

A brief description is appropriate here of the banana industry of the Canary Islands, which is of particular interest, both historically and economi-

cally. The plantations themselves and the cultivation methods practiced differ materially from those of Central America.

Bananas are cultivated on four of the thirteen islands of the Canary Archipelago, namely, Gran Canaria, Teneriffe, La Palma, and Gomera. These islands are of volcanic formation, with high mountain peaks, steep slopes, and limited lowlands. Six of the group are merely desert islands or rocks.

The great problem is water. Because of the exceedingly light rainfall, all crops grown at low elevation are dependent upon irrigation, water for which is derived from winter rains and snows in the higher regions. This is collected by 'galleries,' which are shafts driven into the hillsides to catch the water which flows between the lava strata. This water is led to reservoirs, where as a rule it is allowed to mix with rainwater caught in dams and tanks during the rainy season.

The total area under cultivation is about ten thousand acres. The steep inclines of the slopes and the need of irrigation require the terracing of practically all land under banana cultivation. The walls of the terraces are made from rocks quarried from the hillside. The soil is carefully sifted and in large part made up of soil from other places. Chemical fertilizers, and humus from the forests on the higher slopes are then added; practically all the banana soil on the islands is built up in this way.

The species almost entirely cultivated is the

BANANA PLANTATION IN THE CANARY ISLANDS

TRANSFERRING BANANAS TO SHIPS BY LIGHTER,
CANARY ISLANDS

Cavendish or dwarf banana. Because of its limited height (about eight feet) it is especially fitted to withstand the high winds of the exposed elevations; its hardiness also enables it to endure the cold of the winter season. Cultivation is very intensive. Instead of eyes or 'bits,' entire rootstocks are used, planted about six feet apart in rows ten feet distant. Pruning is carefully done and shoots are allowed to grow so as to occupy the soil fully, and in a short time all regularity of rows is lost. The bud usually appears about twelve months after planting, and the mature bunch is ready for harvesting about six months later.

Cultivation is done with the care characteristic of a country where labor is plentiful and inexpensive. The harvested fruit is carefully packed in crates and taken by motor-trucks, camels, or mules to the coast. Here the crated fruit is loaded into small lighters and carried directly to ships anchored offshore or to the loading ports where it is put aboard the steamships bound for British and Continental ports.[1]

The annual banana production per acre in the Canary Islands is about 625 bunches. In Central America 125 to 150 bunches per acre is a fair average, while in Jamaica, where cultivation is practiced more intensively, the usual crop per acre is 200 to 250 bunches. Production figures vary according to soil, climatic conditions and cultivation methods used.

[1] For description of methods used in packing see footnote, p. 65.

Atlantic Coast of Central America

The Atlantic coast of Central America offers ideal conditions for banana cultivation. It is in this region extending a few miles back from the Caribbean Sea, at an elevation not more than two hundred and fifty feet above sea-level — where there are hot days, humid nights, and an annual rainfall of from eighty to two hundred inches — that the tropical jungle has given way to the greatest banana farms of the world. Within the past forty years an enormous agricultural industry, with its related interests of railways, docks, villages, stores, and hospitals, has sprung up in a region formerly almost uninhabited. Central America may well thank the banana trade for the most progressive influence and constructive development which have ever reached its shores.

BANANA TRANSPORT BY CAMEL, CANARY ISLANDS

BANANA TRANSPORT BY CAMEL, CANARY ISLANDS

CHAPTER V

THE MODERN PLANTATION

A MODERN banana plantation is a striking example of extensive farming, all the more impressive because of its setting of primeval jungle. In the transformation, within a few years, of an untamed wilderness of trees, palms, vines, ferns, and other tropical growth into a vast tract of cultivated land, there is a succession of steps which can scarcely be comprehended by those familiar only with farming operations in the temperate zone.

DEVELOPING THE NEW PLANTATION

In establishing the new plantation,[1] many factors must be considered, such as climate, soil, rainfall, drainage, a shipping port, the risk of damage by floods and hurricanes, and the feasibility of securing labor and supplying transportation. The area under consideration is first thoroughly explored as to its fitness for banana cultivation. Next come the surveying of the land, the construction of a wharf, initial railroads, bridges, tramways, telephone lines, buildings, the clearing of the underbrush, the digging of the main drainage ditches, and, finally, the plant-

[1] The term 'plantation' as used here refers to a new tropical division in Central America, created from virgin territory, and comprising a group of connected banana farms with the equipment necessary for their unified operation.

ing. Then follow the gradual development and extension of the plantation until vast areas are pouring their product with regularity into the holds of the steamships at the loading ports.

It is essential that a supply of foodstuffs and merchandise be made available at reasonable prices. Hospital treatment must also be provided in event of sickness or accident, and the general sanitary condition of the plantation and the welfare of its employees must be properly looked after in order that an efficient organization may be maintained.

The land, when originally surveyed, is laid out in sections of a size convenient for the allotment of the work, and for the keeping of proper records of operating costs and production. On each farm the personnel consists of overseer, or 'mandador,' timekeeper, foreman, stockman, and laborers.

The quality and condition of the fruit as well as its prompt and careful handling are the all-important factors. To dispatch the modern type of refrigerator steamship at regular and frequent intervals, with a cargo of from 45,000 to 85,000 stems of prime, freshly cut fruit, requires, first of all, a vast area of good producing land, connected with the tropical port by extensive railways. These in turn are fed by a network of light tram-lines. In some instances, the fruit is hauled seventy miles by rail. On the farms the number of riding, work, and pack animals required amounts to thousands, and a small army of laborers is constantly occupied.

Each plantation must have good telephone com-

UNDERBRUSHING, LINING, AND PLANTING

FELLING LARGE TREES AFTER THE PLANTING

BANANA PLANTATION THREE MONTHS AFTER PLANTING

BANANA PLANTATION SIX MONTHS AFTER PLANTING

munication with its district headquarters and with the central office of the division for the prompt distribution of cutting advices, control of fruit deliveries, and operation of the fruit trains. This central office communicates by radio with the head offices in the United States and with the ships en route. Every effort is made to have the bananas arrive at the loading port as soon as the steamship is ready to receive them, and to have the fruit loaded in the briefest possible time. The whole operation constitutes a most interesting example of organization and attention to detail.

Planting

The plantation is developed from virgin land, covered, as a rule, with forest and a dense tropical undergrowth. After the land has been selected and surveyed, and the drainage ditches have been completed, it is underbrushed, lined, and staked; then it is ready for planting. Underbrushing, as the term implies, consists in chopping down the undergrowth with cutlasses (machetes), in order that the workers may move about more freely among the trees. Lining and staking consist in carefully laying out and marking the land with stakes set at the interval at which it is intended to plant, in order that the young plantation may have regularity and orderliness. The distance between the stakes varies according to soil and climatic conditions. In Central America the planting distance is usually from eighteen to twenty-four feet each way and in Cuba

and Jamaica, owing to the small growth of the tree, about fifteen by fifteen feet.

As the seeds of the banana are rarely developed in the cultivated varieties, the planting is done with pieces of rootstock. The rhizomes, usually selected from adjacent vigorous cultivations, are cut into portions, or 'bits,' weighing from three to four pounds each. Care is taken to see that each bit has at least one good eye; only the larger bits are used, as the smaller produce weak plants. After the bits have been carried to the place where they are to be planted, they are again inspected and those with bruised eyes are rejected. At each stake, a hole about twelve inches deep is dug, in which a bit is placed, with an eye toward the bottom, and covered with earth.

Cultivation

With the completion of the planting and before the young plants have appeared above the surface of the ground, the larger trees are felled, the dense growth making this operation laborious and expensive.[1] The tropical forest usually contains a large variety of trees, many of them of great size. Of these huge trees the Ceiba and the Guanacaste are the most frequently found.

After the felling, the future plantation is an almost impassable tangle of stumps and trees, with

[1] Where irrigation is necessary for the successful cultivation of bananas, the felling usually follows immediately after the underbrushing and the whole mass is then burned, after which the land is lined, staked, and planted.

interlocked branches and matted vines. In fact, its aspect at this stage is that of a heavy forest shorn off at the ground and laid flat in a confused mass, giving the impression that one is in the wake of devastation instead of in the midst of a banana farm in the making. Through this mass must be cut the right of way for narrow-gauge tramways and roads. This stage in the development of a plantation is a very critical one. A drought may occur, in which event many of the bits will not germinate, and it is necessary to replant. Or the felled timber may catch fire with disastrous results to the planting. On the other hand, in the event of heavy rains, the area may become flooded, and that is equally harmful to the young banana plants.

To the outsider it might appear that the felling of the trees on the newly planted ground would entirely destroy the young plants; this, however, is not the case. Felling is done before the bits have started to sprout, and even if a tree crashes down on one of them, the plant will usually grow up around the log and adjust itself to the situation. The enormous quantity of logs, branches, leaves, and trash covers the ground like a mulch and, instead of being destructive, actually establishes the most favorable conditions possible for the growth of the banana plants. A hot, humid atmosphere and a wealth of fungous and bacterial organisms cause the felled trees to decay, adding humus to the soil. The smaller branches and twigs decay quickly, while the larger branches, and most of the trunks, will completely

rot away within two or three years; to remove especially hard timber, burning is sometimes resorted to.

About three months after the planting, the banana farm is ready for its first cleaning. This involves chopping off the smaller limbs and branches of the felled trees, as well as cutting out the weeds and tropical growth which have sprung up and which, if left, would soon choke out the young banana plants. From now on the plantation has to be cleaned at intervals of at least every three or four months. In the course of these various cleanings much of the original felled growth is carried off or decays, although the stumps and logs of the larger trees may remain. At each cleaning, any failure of the original rhizome to come up, commonly termed 'a miss,' or any damage to the young plants by felling or from ravages of animals, has to be overcome by 'supplying,' i.e., replanting. This is usually done with suckers about six months old, although bits are occasionally used. By means of a sharp mattock these suckers are cut cleanly off from the parent rootstock, and are carefully handled so that the small roots will not break off. The young plant, after the green leaves are cut back, is set out in its place in the row; and soon begins to take root and to send out new leaves.[1] In a large measure the success of the plantation depends on the 'stand' obtained from the original planting.

[1] In Jamaica the sucker is planted somewhat deeper than is the case in Central America, the holes being dug as deep as from eighteen inches to two feet and proportionately wide.

'SWORD SUCKER' SIX MONTHS OLD, GENERALLY USED FOR 'SUPPLYING'

CROSS-SECTION OF PSEUDO-STEM, OR 'TRUNK,' OF BANANA PLANT, SHOWING FRUIT STEM AND OVERLAPPING LEAF-SHEATHS

A 'BLOW-DOWN'

HARVESTING THE BANANA

As the plantation develops, each rhizome sends up new suckers, or shoots, on all sides of the original plant. Only a few of these are allowed to grow to maturity. In an old plantation each hill, or 'mat,' consists of from half a dozen to a dozen plants standing more or less close in an area which may be several feet in diameter; thus the alignment of the young plantation is gradually lost and the rows become irregular.

A great deal of other work must be done simultaneously with or soon after the planting, in order that the crop, which begins to come in from twelve to fifteen months later, may be properly handled. As the banana plantation is established on virgin land, the operations may be either a few or many miles from any habitation. Completion of railways must follow closely upon the planting in order that supplies and material may be brought in for laborers and for construction. Quarters for salaried employees and laborers have to be built, areas cleaned, pastures made for work animals, and tram-lines laid down through the plantations as fast as the right of way can be cleared through the felled land.

It is a race against time to accomplish all of this, and the uncertainty of Nature's elements constitutes a great hazard. Owing to the heavy and irregular rainfall, both farm and construction work are continually interrupted. The most promising outlook may sometimes be turned into disaster overnight by a windstorm, sudden flood or drought, and months of time and labor thereby lost.

On account of the soft, porous soil and the heavy precipitation, it is found more economical and efficient to supply the plantations with a system of light tram-lines, rather than to attempt to build wagon or cart roads on which to bring out the fruit, which can be carried by men or packed on animals only a very short distance, especially during wet weather. Consequently a vast network of tramways is necessary, with the lines sometimes only a few hundred yards apart, the cars in many cases being hauled by draught animals.

After the primary construction period has passed, a large force of laborers is constantly required to keep in check the riotous tropical vegetation, and to give each section its cleaning and supplying at the proper time. Old drainage ditches have to be cleaned out and new ditches dug. Innumerable small bridges for the tram-roads require almost incessant attention and repair. Part of the necessary labor is also organized into gangs for harvesting the fruit on 'cutting days.'

The banana plantation must be always ready for various emergencies. At times, excessive rains cause the rivers to overflow their banks and change their courses; great loss in large banana areas or even total destruction sometimes follows, as well as heavy damage to the main roadbed and bridges. Occasionally a hurricane may sweep through a district, causing a total loss of the crop. Even windstorms of a velocity not exceeding twenty to thirty miles an hour often prove very destructive to banana

plantations, especially to the trees bearing fruit ready for cutting, which, on account of the heavy weight of the bunches, are liable to be blown down. Then, again, a drought may seriously retard or damage the fruit; also, ravages of insect pests, such as locusts, must sometimes be combated. All these and other conditions necessitate frequent revision of the estimate of the plantation output in order that steamships of the proper carrying capacity may be supplied.

Since the banana is a very prolific reproducer, it is necessary to cut down many of the young plants after the first crop in order that they may not become overcrowded. Within a certain limit, the fewer suckers allowed to grow from a single rhizome, the more hands (clusters of fruit) will be produced by the remaining trees originating from that root. Usually only from two to five of the most promising shoots are allowed to develop. This process of cutting away some of the shoots (pruning) is a work that requires considerable skill and judgment to obtain the best results. As the plantation comes into full bearing, new shoots mature and replace those which have already borne fruit and have been cut down; after a time, as a result of a single planting, production becomes practically continuous over a period of years.

The average annual banana production per acre is 125 to 150 bunches in Central America and 200 to 250 bunches in Jamaica, where cultivation is practiced more intensively. Production figures vary

according to soil, climatic conditions, and cultivation methods used.

Usually first-class land planted to bananas is good for the production of salable fruit for a period of ten years, or a little longer. Before that time, in the case of second-class land, soil-starvation or disease manifests itself in smaller stems of fruit, fruit irregularly disposed on the stem, or in a failure to produce fruit. It is then a question of facing a steadily diminishing crop or of fertilizing or in some cases abandonment. If the land is abandoned, it may eventually be planted to some other crop.

Harvesting

Definite loading orders are transmitted by radio from the head office in the United States to the central office of the tropical division, in advance of the arrival of the steamship at the loading port. In due course each district headquarters receives cutting orders, based on the carrying capacity of the vessel as well as the estimated quantity of available fruit of the required grade, and in turn gives the necessary instructions to the farms. Each farm overseer makes his allotment to the individual sections and to the cutters, and sees that everything is in order to start the cutting at daylight. Rigid inspection is enforced by the farm overseer, foremen, selectors and travelling inspectors, from the time the cutting commences until the fruit is loaded on railway cars.

Cutting of the fruit in a given section is done at

'BACKING' THE BUNCH

'PACKING' BANANAS

BANANA SLING HANGING READY FOR 'PACKING'

BANANA-LOADING 'PLATFORM' (STATION) ALONGSIDE RAILWAY

DELIVERING BANANAS BY STEAM-TRAM TO RAILWAY

least once a week, and sometimes twice. Since the fruit is in various stages of development, a practiced eye is required to select the bunches of proper grade for shipment. A cutting gang usually consists of three men: the 'cutter,' the 'backer,' and the 'muleman.' The cutter, using a long pole with a special knife fitted to one end, nicks the trunk of the tree, a few feet below the bunch, causing it to bend where it has been cut. With the pole, the upper portion of the tree is then steadied to prevent its coming down with a rush and crushing the fruit. The backer receives the bunch on his shoulder; the cutter severs it from the tree with a machete and cuts off the blossom end. Immediately the backer carries the bunch to the nearest pack-road or tram-line. Then the tree itself is cut down near the ground, where it quickly rots and becomes good fertilizer for the soil.

Transportation to the Loading Port

Without loss of time the fruit is carried out on pack animals in charge of mulemen, or is loaded on tram-cars for transportation to the railway. In some instances, when the railway is very near, the bunch is 'backed' right out to the track; in others, it is first backed a short distance, then packed on a mule, and finally loaded on tram-cars. According to the location of the plantation with respect to the tram and railway facilities, the pack by animals, as well as the haul by trams, is of varying distance. On some farms animals are used to draw the trams,

while on others small locomotives are employed on account of the long, heavy hauls.[1]

When the fruit arrives at the railroad, one of two methods is employed in transferring it to the railway cars, the particular method depending on the quantity of fruit assembled at one point, the location, and the track facilities. Where possible, the trams are run to sidings, or spurs, on the main line, and the fruit is passed from the tram-cars to the waiting railway cars as fast as it comes out from the farm. In other cases, the bunches are placed alongside the track on platforms of turf or wood, and covered with leaves, to be loaded subsequently on fruit trains by loading gangs who travel with them.

Special trains of empty banana cars, each with its inspector and loading gang, are dispatched from the terminals as soon as cutting is well under way. These trains travel over the banana lines, receiving the fruit placed alongside the track, picking up cars loaded at the sidings, and assembling them at central points. As fast as sufficient loads are collected, they are forwarded to the port in trainloads of from twenty to forty cars. At all the principal banana-loading ports, the cars of fruit are switched to the dock.

[1] In Jamaica the method of cutting and hauling fruit is different from that used in Central America. Each cutter in Jamaica is followed by numerous 'headers'; as soon as the bunch is cut, one of the headers carries it to the road or terminal; as many as ten to twenty headers follow each cutter. From the road the fruit is transported to the nearest agency by motor-truck, ox-wagon, mule-wagon, tram-car or railroad, according to the circumstances of the case.

CHAPTER VI

OCEAN TRANSPORTATION

Loading the Banana Cargo

Immediately upon the arrival at the wharf of the first trainload of bananas, the loading of the steamship begins and continues day and night without interruption until completed. At first glance, the pier presents a scene of indescribable confusion and gives the novice the impression of vast undirected energy. In reality, the operation is a carefully coordinated movement, with every activity at top speed. The cutting orders and the train schedules are so arranged that a continuous flow of fruit is assured. A cargo of 85,000 bunches is dispatched in about fifteen hours.

The fruit is passed from the cars to the loading machines, where it is again inspected and all damaged or defective bunches, as well as any showing excessive fullness or the slightest yellow color, are rejected. Those accepted for shipment are then counted as they are placed one by one in the canvas pockets of the conveyor, or endless chain, which takes them into the holds of the steamship.

Here experienced gangs of laborers under direction of foremen receive the fruit and carefully stow it in the various compartments and bins. Each class of fruit is usually put by itself. Bunches are stowed on end, resting on the lower end (butt) of the

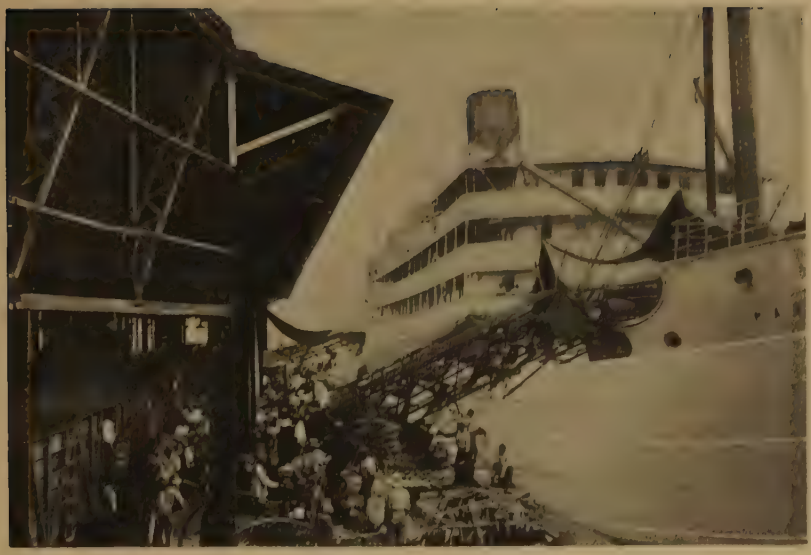
stalk, in from one to four tiers in the following manner: one, two, or three standing (end to end); one, two, or three standing and one flat; or, one or two standing and two flat. The spaces between bunches, between hands and stalks, and between the fingers, form natural channels for the circulation of air.

As the loading of each 'deck' is finished, the delivery-end of the conveyor is raised to the deck above. On completion of the loading of the top deck, the conveyor is removed, the hatches are put on, and, if the steamship is refrigerated, the cooling of the cargo is begun. Stowage plans, showing the location and quantity of the different classes, are prepared to facilitate the proper discharge of the cargo upon arrival.

The Banana Steamship

For the successful ocean transportation of bananas, especially designed steamships are necessary, particular attention being given to air circulation and ventilation. Both refrigerated and naturally ventilated vessels are used. Ships of the latter type are generally used on the shorter runs. They are equipped with large ventilators, placed at convenient points, to supply fresh air and draw out the stale air. These ventilators are manipulated by turning the large intake cowls toward or away from the wind, as the occasion demands.

The forward and after holds of all banana-carrying steamships are divided horizontally into three or four compartments, or 'decks.' These are desig-



LOADING THE BANANA STEAMSHIP

STOWING BANANAS (TWO STANDING AND ONE FLAT) IN HOLD OF STEAMSHIP

REFRIGERATED BANANA STEAMSHIP

nated as 'upper 'tween deck,' 'lower 'tween deck,' 'orlop deck,' and 'lower hold'; when there are only three compartments, they are called ''tween deck,' 'lower 'tween deck,' and 'hold.' All ironwork is properly sheathed, and rough surfaces as well as sharp corners are eliminated to prevent bruising and discoloration of the fruit.

Each compartment is divided into bins of convenient size by vertical wooden partitions of open construction called 'shifting boards' (similar to the old farm gate). These wooden bars, or bin boards, keep the fruit from shifting and from becoming crushed from the roll and pitch of the ship in heavy weather.

Refrigeration, as applied to banana cargoes, is the treatment of the fruit with cooled and properly conditioned air, and should not be confused with the customary cold-storage operation in which low temperatures are essential.

In transporting banana cargoes in good condition, there are three principal opposing factors to be met, i.e., heat, humidity, and vitiated air. At the beginning of a voyage when hatches are closed, these three factors are exerting their maximum influence against the fruit. During this time the temperatures of the outside atmosphere and of the sea-water are also at their maximum. This is the most critical period for the banana cargo, and quick control of temperatures, with full efficiency of refrigeration, is imperative. As the impure atmosphere created by the respiration of the fruit has a potent ripening influence, it is essential that the air in the holds be

kept fresh, especially during the period of temperature reduction.

The problem is to carry the fruit well-ventilated within a narrow range of temperature. It is the usual practice to 'pre-cool' the holds of a refrigerated steamship for a period of about twelve hours just prior to loading. When the vessel is loaded, every effort is made to reduce the temperature of the holds to the desired degree in the briefest time possible, and to maintain it at that point throughout the voyage. Under normal conditions the temperatures are 'down,' i.e., the fruit under control, when the temperature of the air exhausted from the holds, is at 57° F. In the more modern ships, this is usually accomplished in about thirty hours; from then on, only about one tenth of the refrigerating power is required to deal with the cargo, and the operation is conducted accordingly.

In refrigerated steamships, the holds are heavily insulated with cork, cowhair, or other suitable material. The fruit is cooled to the required temperature with air circulated by powerful motor-driven fans, first over brine coils (through which cold brine is constantly passing) and then through the fruit holds. The air is returned to the fans, supplemented constantly with a certain amount of fresh air, and is again circulated over the fruit cargo.

The refrigerating plant comprises in general: (*a*) a compressor, by which the CO_2 gas is drawn from the evaporator and compressed; (*b*) a condenser, in which the warm compressed gas is cooled

and liquefied by salt water circulating around the coils; (*c*) an evaporator, consisting of coils, in which the liquid carbonic anhydride (CO_2) evaporates, producing any required degree of temperature down to 80° F. below freezing point; (*d*) a brine battery or cooler composed of a series of brine pipes, connected by a common-header, with delivery and return lines to the brine pumps in the engine-room.

During the cooling process, which is continuous throughout the voyage, the heat from the bananas is carried by the air to the brine-filled coils; the warm brine is returned to the main plant in the engine-room; here the heat, originally drawn from the fruit, is transferred to the CO_2 gas, and is then taken up by the sea-water circulating around the gas coils, which is finally discharged overboard. In this operation there are three complete cycles in which five agents are used — in the first cycle, air; in the second cycle, brine and calcium; and in the third cycle, CO_2 gas and salt water.

Although banana cargoes are carried at a much higher temperature than meat, the refrigerating machinery used is much more powerful. The reason is that meat is already chilled when loaded, while bananas are not only warm when put aboard ship, but generate heat in considerable volume. At the beginning of the voyage the temperature of the banana cargo is highest, and the generation of heat decreases as cooling progresses. In the early stages of cooling, the amount of heat given off by the

average cargo of bananas is about 8,000,000 British thermal units per hour.

Throughout the voyage the fruit is carefully inspected at frequent and regular intervals — day and night — and the temperatures of the holds noted and recorded by the refrigerating engineers. Intermittent with their inspections are those of the deck officers, which give an alternate check and reduce the possibility of error in the readings of the thermometers. A sudden rise or drop of even a degree in some section of the hold is a matter for immediate conference among those in charge.

As the temperatures vary, the refrigerating machinery is operated accordingly — a little more brine here, a little less there, until the desired temperature is finally secured. In the winter season, when approaching a North Atlantic port, it is sometimes necessary to use artificial heat to maintain the desired temperature. For this purpose, on refrigerated steamships, the brine in the coils is heated by steam and, on naturally ventilated vessels, steam is circulated through pipes in the holds.

According to the distance, route, and the speed of the vessel, the voyage from the various banana ports of Central America and Jamaica to New Orleans, Mobile, or Galveston consumes from three to five days; to Boston, New York, Philadelphia, or Baltimore, about seven or eight days; and to British and Continental ports, fifteen or sixteen days. On account of the longer ocean voyage, the bananas shipped to the European market are of a slightly

thinner grade (less fully developed) than those sent to the United States.

Mr. E. S. Gregg, Chief of the Transportation Division of the United States Department of Commerce, in his article 'Trading with the Tropics,' which appeared in 'Economic Geography,' October, 1925, states:

> The effect of geographic factors on tropical shipping is seen most clearly in the fruit ships. These vessels have a value for our trade in excess of their numbers. They maintain regular communications with our small neighbors to the south. Carrying mail and passengers, they make possible a constant exchange of ideas and business details. They give an assured outlet for the tropical produce of the Caribbean and make it possible for northern articles to be obtained in exchange.

CHAPTER VII

MARKETING

Discharging the Banana Cargo

The problem of discharging banana cargoes varies with the local conditions existing at the different ports. While the steamship is nearing the wharf, every preparation is made, both aboard the vessel and on the pier, to commence unloading as soon as the ship is made fast.

During the discharge of the cargo, the wharf presents a busy and interesting scene. The work of the stevedores under the direction of the superintendents is a striking example of the speed and accuracy of a system evolved from long experience.

At New Orleans, Mobile, and Galveston the banana piers are equipped with unloading machines, each with a capacity of about two thousand bunches an hour. The great booms of these machines (similar in type to those used in the tropics for loading) are lowered into the holds of the steamship. A bunch is placed in each canvas pocket of the endless chain, elevated to the top of the machine, and then carried across and down to the wharf, to be turned out automatically onto horizontal belt conveyors which, at the port of New Orleans, distribute the bananas to the doors of the refrigerator cars. All three fruit decks are unloaded at the same time, the longshoremen in the bottom deck placing a

Horizontal conveyors carrying bananas from unloading machines

Horizontal conveyors delivering bananas to railway cars

UNLOADING THE BANANA CARGO AT NEW ORLEANS

Elevators and conveyors discharging bananas

Elevators and conveyors delivering bananas from ship to car float

UNLOADING THE BANANA CARGO AT NEW YORK

bunch in each third pocket, leaving two empty pockets to be filled from the middle and top decks, so that finally every pocket of the conveyor contains a bunch of bananas.

As each bunch reaches the point of discharge, its disposition is determined according to its classification, condition, and quality, by inspectors stationed on both sides of the delivery belts. Other inspectors, in front of each car door, scrutinize every bunch very closely as it comes up, rejecting any fruit that is scarred or not in condition for shipment to interior points. As they are loaded into railroad cars or other vehicles, all bunches are carefully counted by means of checking machines.

Machinery is also used for the unloading of banana cargoes at New York. The equipment was especially designed to accommodate Northern climatic and terminal conditions, both of which differ widely from those obtaining in the South. At New York bananas are discharged simultaneously to railroad cars on floats alongside the steamship, to railroad cars on floats across the pier, and to automobile trucks on the pier. When loaded, the car floats are towed to the various railroad terminals where the cars are transferred to the mainland.

The New York machinery consists of two units, both of which are portable. The first is a self-contained electric elevator which is hoisted on board by means of the ship's tackle. The elevator is placed on the well deck in the summer and on the upper 'tween deck in the winter. This equipment

lifts the bunches of bananas from the lower holds and lower decks in rubberized canvas pockets. On arrival at the well or upper 'tween decks, the bunches are transferred to electric trough belt conveyors which carry the bunches from the ship to the dock or to the railroad car alongside the steamer. The equipment has practically eliminated the handling of the bunches except for a short distance from the end of the belt conveyors to the automobile trucks or railroad cars. The belts, which extend through the steamships' ports, are sheltered in winter with canvas canopies to protect the fruit from the cold.

At Boston, Philadelphia, Baltimore, and Charleston belt conveyors have been installed similar to the New York equipment, while the discharge from the lower holds and lower decks to the upper decks continues to be performed by hand. Stevedores are placed on the 'stages' in the hatches of the vessels; the bunches are passed from one man to another and are placed on the belt conveyors for transportation to the pier whence they are carried to automobile trucks or railroad cars.

A wide variation in terminal facilities at Northern ports has prevented the complete installation of standard unloading equipment or even the portable machinery now being used successfully at New York. Experiments are still being conducted with a view to eliminating the 'stage' method and the time is not far distant when the difficulties will be entirely overcome and all banana cargoes will be discharged by machinery.

LOADING BANANAS IN RAILWAY CARS IN WINTER

BANANA RIPENING ROOM

BANANA WAREHOUSE IN OUTSKIRTS OF PARIS
Upper: Exterior. Lower: Interior

Shipping by Rail to Interior Points

After being thoroughly inspected and equipped, the cars are weighed empty before being placed for loading and, when loaded, are again weighed to secure the accurate net weight of the bananas. This is the same procedure that is followed in the case of motor-trucks and wagons. The loaded cars are then made up into trains and dispatched over the various roads on fast schedules.

In the loading of railway cars, the bunches are placed upright, resting on the lower or butt end, and are stowed close together, any additional bunches needed to make up a standard carload being laid flat on top of the standing fruit. Loading is started at each end of the car and when the centre, between the doors, is reached, boards are nailed across the doorways to prevent the fruit from falling out when the doors are opened.

Bananas are inspected and weighed at the seaboard by men especially appointed or licensed to do this work. The inspection is very rigid and any fruit showing evidence of damage or a degree of maturity which forecasts too early ripening, is rejected for interior shipment and is sold locally.

In transit from seaboard to destination the bananas are inspected and the temperatures taken by caretakers called 'messengers,' who report on the condition of each car and make any changes in ventilation, heating, or icing necessary to insure the arrival of shipments in good condition. They either accompany the trains from the seaboard or are

stationed at strategic divisional and junction points. These messengers are expert men provided by the Fruit Dispatch Company to protect the interests of the jobbers who have purchased the bananas at seaboard. They are at all times the agents of the jobbers and as such are always subject to their instructions respecting the fruit in the cars. In the absence of such instructions the messenger follows the rules laid down by the Company on behalf of the jobber.

Both the shipper's office at seaboard and the consignees are kept in close touch with the progress of the banana cars, through telegraphic advices from these messengers. By means of this service many losses otherwise incident to transportation are prevented. The men in this far-flung messenger service are ever alert and watchful of the jobbers' interests. No vigil is too long and no task too arduous for them to carry out their single purpose, the protection of banana shipments from seaboard to the unloading track of the jobber.

The fruit is carried into widespread territory in refrigerator cars equipped with slatted floor racks, providing an air space of from four to six inches under the load. By coöperation between shippers and the various railroads and car lines, these refrigerator cars have been brought to a high standard, although experimental work is still being done to improve design and construction.

During the warm season the cars are usually iced, with due regard to the outside temperature and

the distance to be travelled. Continuous refrigeration is obtained by icing at seaboard immediately after the loaded cars are weighed, and by re-icing en route as may be necessary. Large cakes of ice are used instead of crushed or small cakes, as the large cakes present less surface to the atmosphere in proportion to weight, and therefore melt more slowly, producing a mild cooling effect over a longer period. Convenient icing stations are established by the railroad companies at various divisional and junction points, and the cars are quickly re-iced in transit as a result of advance notice given through the messenger service.

An important feature that must never be overlooked is ventilation. The ventilators of the car are carried partially open, providing the necessary amount of fresh air to preserve the vitality of the fruit and at the same time to prevent over-refrigeration.

In the winter season the cars are papered and more or less heavily 'strawed,' according to the weather conditions, and heated as an added precaution to insure good deliveries. At Northern seaboard points the cars are given an initial heating before they are loaded and, when necessary, they are again heated after being loaded and before they are started on their way. For winter emergencies there are three large heating plants, one located at Rouses Point, New York, for the handling of shipments from the Eastern seaboard into Canada, and one each located at Mounds, Illinois, and Dubuque, Iowa, for

the handling of shipments from Southern ports destined to the North and Northwest. The plant at Mounds is the largest of the three and is capable of handling seventy-two cars at one time. If unusually cold weather prevails, the fruit can be warmed by switching the cars into these heating-sheds and treating them with warm air, either by means of a blower system, which delivers warm air through ducts to each car, or by means of steam radiators laid between the rails beneath the cars. For the further protection of banana shipments to northern parts of the United States and to Canada, car-heater stoves are provided by the railroad companies at convenient points.

The distribution of bananas in North America is in general as follows: Importations through Gulf ports are sent throughout the Southeast, south of the Ohio and Potomac Rivers, the Central West, including the great territory lying west and north of the Mississippi River, as well as to western Canada; importations through Atlantic ports are distributed mainly throughout the Eastern States, the territory north of the Ohio and the Potomac, as far west as Columbus, Cleveland, and Detroit, and to eastern Canada.

Bananas move in trains of fifty to one hundred cars, which maintain fast schedules. From New Orleans the running time to some of the larger cities is about as follows: Chicago, the largest inland banana market in the world, 55 hours; Minneapolis, 88; Winnipeg, 112; Seattle, 184; and Vancouver,

208 hours (nearly 9 days). From New York and Philadelphia the fruit is shipped to Cleveland, Detroit, and Toronto usually in about 36 hours. In the summer months bananas find their way to points even beyond the Arctic Circle.

Banana traffic is of great importance to the railroads of the United States, for as a rule the haul is long and in a direction opposite to that of the bulk of railroad traffic, a condition which helps to balance tonnage and reduce the percentage of 'light-engine return movement.'

Selling the Banana

Most of the bananas imported are marketed through sales branches, located in all the important centres of the United States and Canada. These branches solicit and receive orders for the fruit from the jobbing trade in their respective territories. The orders are telegraphed or telephoned by the branches to headquarters at the seaboard, for acceptance, and are usually received before the cargo of bananas is discharged, although orders are at times taken for cars which have already been shipped from the seaboard. The branch manager is the sales representative in his territory — the direct contact between the jobber and the banana company.

A portion of the fruit arriving at Atlantic ports is sold locally by auction in truck lots. Bananas are sold to the jobbing trade on the weight basis; most retailers sell them by the dozen or hand.

Sales Promotion Work

In addition to the messenger service previously referred to, the Fruit Dispatch Company through its sales promotion work furnishes without charge an equipment and a field service for the jobber and a dealers' service for the retailer. The three departments are represented by men who are specialists in their particular lines.

The equipment service is carried on by a corps of engineers who prepare for the jobber plans of modern plants for ripening bananas and give technical advice as to their construction.

The field service men assist and advise the jobber on his other problems. They give many valuable hints on the care and handling of bananas that save time and labor, with the result that many losses are avoided.

The dealers' service men, so called, are experienced in the methods of retail merchandising of bananas. They advise on the proper care of the fruit to avoid 'cooking' during summer and chilling in winter; they also prepare window displays and give the retailer many valuable and practical suggestions which, if followed, result in more advantageous marketing.

Handling by the Jobber

The successful banana jobber is on the lookout for his shipments, unloads them quickly, and devotes great care to the physical handling of the fruit in order to prevent scarring and bruising. When the

railroad car is unloaded at a distance from the banana-rooms, the fruit is properly protected in the motor-trucks or wagons used in transportation. If the car is discharged at the jobber's unloading platform, an overhead track with trolley hooks is frequently used to convey the bunches to the banana-rooms.

In winter, protection against chilling is afforded by the use of stoves in the cars during unloading, and by thoroughly 'strawing' the trucks and wagons; moreover, each truck or wagon load is covered with blankets or tarpaulins. Throughout most of the Northern territory, vans somewhat resembling those used for carrying furniture, and heated with small stoves, are used for transporting the fruit from the cars. When the car is placed at the jobber's unloading platform, canvas windshields are employed to protect the fruit while it is being moved from the car door to the building.

A part of the jobber's distribution is represented in the shipment of single bunches of bananas by freight or express. Special crates of various sizes and designs are manufactured for this purpose. The returnable crate is constructed of wooden slats with a burlap bag suspended within and so tied to the structure that the bunch cannot be bruised by contact with the outer frame. The non-returnable crate is made of light slats, and in it the bunch of bananas, placed in a paper bag manufactured for the purpose, is packed with straw or hay. Jobbers handling the smaller classes of fruit frequently

use cylindrical cardboard drums strengthened with wooden bottoms and hoops.

Banana-Rooms

An important link in the long chain of operations extending from the plantation to the retail store is the careful handling and proper ripening of the green fruit in the banana-rooms of the jobber. The present advanced type of room has been designed with a view of simplifying the handling and the marketing of bananas as a properly matured product at their maximum food value. This type of room also minimizes losses through shrinkage by evaporation, as well as from over-ripeness and decay.

Since ripening is recognized as a vital phenomenon resulting from changes taking place within the cells of the fruit, it is necessary to have normal, wholesome conditions in the banana-room. Provision is made for fresh-air circulation and for the maintenance of the required temperature, as well as for the proper humidity. In order that an even temperature may be maintained, whatever the weather conditions, the room is well insulated and fitted with special heating and refrigerating apparatus; the heating appliance is so designed that the products of combustion are carried off. A gravity system of ventilation constantly supplies fresh air, and removes the vitiated air which results from the respiration of the bananas and increases rapidly during the ripening period. Bunches are hung from ceiling hooks, properly spaced to permit requisite

air circulation, and convenient handling without bruising. In order better to fill the room to capacity, the ropes attached to the ceiling hooks are knotted at intervals to allow the bunches to be hung high and low, or in double tiers.

There exists among jobbers a variation of opinion as to the correct temperature for ripening bananas and the time required for coloring the fruit, due to the fact that in many cases temperature only is considered, and its relation to humidity and ventilation, two equally essential factors, is disregarded.

In rooms properly built and equipped, bananas are ripened most successfully at temperatures ranging from 62° to 66°, provided the relative humidity of the surrounding air is maintained at approximately 85 per cent until the fruit is well on the 'turn.' At this stage, in order to season or harden the fruit so that it may better withstand the extreme conditions existing in the retailer's store, the percentage of relative humidity should be reduced to 70 or 75 per cent. During this seasoning or hardening period, it is advisable to reduce the air temperature to approximately 62°.

The following temperatures (Fahrenheit) may be taken as standard when used with the proper percentage of relative humidity:

56° .....Holding ripe bananas
58° .....Holding green bananas
60° .....Slow ripening
62° to 66° .....Normal ripening
68° .....Fast or forced ripening
72° or over .....Danger of cooking

High temperatures, 72° to 85°, are frequently used throughout the ripening period and undoubtedly a great deal of harm is done by this fast ripening, causing poor appearance and color. Such ripening can be brought about only at the expense of flavor, food value, and keeping quality. Bananas ripened in this way deteriorate very quickly when placed in the window or on the stands of the retailer. In cold weather especially, bananas so ripened take on an extremely poor appearance in a very short time. High temperatures cause shrinkage in weight, destruction of tissues, and quick deterioration. Forcing is usually resorted to by jobbers operating in cramped quarters, who, in order to meet the demands of their trade, ripen fruit to turning stage within two and one half to three days when four or five days are normally required. High temperatures of 70°, 75°, and 80° should be used only on fruit that is cold when unloaded from car or truck, and then for a very short time only — twelve hours or less.

Handling by the Retailer

The retailer's approved practice is to cut off the hands of bananas from the bunches when received from the jobber, and to display these hands where they will be readily seen. Due care is taken in winter to protect the fruit from draughts of cold air, and at night it is covered in case the temperature may be low. In the severing of the bananas from the stalk, a knife is used, to avoid tearing the skin and

exposing the pulp. This feature of retail service should always be insisted upon by the purchaser, in order that the natural germ-proof package may remain intact.

The European Market

Conditions in the banana business in Great Britain differ materially from those in the United States, where a short sea voyage is succeeded by a long railway haul. In Great Britain the situation is reversed. After the sixteen-day sea voyage the railway hauls are short, the longest (that from Avonmouth to Inverness) being 615 miles. Within twenty-four hours of the arrival of a cargo of bananas from the West Indies or Central America, the entire shipment is safely housed in the jobbers' stores in every part of the United Kingdom.

At present bananas are marketed in all the European countries, except Russia. Bergen, Norway, now has a regular 'banana' connection with Iceland. Trondhjem, Norway, has probably the northernmost banana warehouse in the world, and delivers the fruit to Spitzbergen, halfway to the North Pole!

Abroad, the display of a bunch of bananas for sale is now a thing of the past. There the bananas are ripened, cut up into hands, packed in standard boxes, and transported in motor-trucks to the retailers in the small towns and villages. This method of cutting and shipping is known as the 'flatting' system and is used universally in Great Britain and on the Continent, with great success.

CHAPTER VIII

FOOD VALUE

DURING the past twenty years there has been remarkable progress in knowledge of nutrition. The World War compelled every one to think seriously of food production as well as nutrition and was a large factor in establishing real education in food values and food economics.

To-day, the public knows that there are few, if any, complete foods, and that daily requirements must be met by the purchase of several varieties, many of which in part are duplicates. This knowledge has made the people better judges of what to buy and also keener critics of the claims of rival food products.

Since finances as well as health play a part in this selection, the significant problem of to-day is how to purchase at minimum cost all the articles that are necessary to the daily food supply. 'On the average, half or more of the family income is spent for food. In the household of a wage-earner food is the largest single item in the family budget.'[1] As an editorial in the 'Journal of the American Medical Association'[2] puts it: 'The leading economic

[1] McCollum, E. V., and Simmonds, Nina: *The Newer Knowledge of Nutrition* (3d ed., New York, Macmillan, 1925), p. 52.

[2] October 24, 1925.

question now before the people is the purchase of staple foods at moderate cost.'

Of equal importance to public health is the problem of a rational, i.e., well-balanced diet. Indications are that we are not solving the questions of diet raised by changed living conditions, decreasing physical exercise, and new and different types of food.[1]

A staple food is one that is abundant, always obtainable, of moderate cost and high food value, as well as palatable and easily digested. One of the most important of staple foods is the banana. This chapter presents the salient facts with respect to its food value, developed by leading authorities in economics and dietetics.

General Facts of Nutrition

Food is required by the body for the production of energy and heat; for the restoration of tissue lost through wear and tear; for growth; and for protection against disease. To fulfil these purposes, the daily ration must contain the following nutrients:

Carbohydrates, in the form of starch and sugars. These are supplied for the most part by cereals, vegetables, and a few fruits.

Proteins. These nitrogenous compounds are derived principally from meats, eggs, milk, cereals, and such vegetables as peas and beans.

Fats of animal and vegetable origin.

Mineral Salts, principally of calcium, phos-

[1] Cf. *Annual Report*, United States Public Health Service, December, 1925.

phorus, and iron. The amounts required are relatively small but are of great importance.

VITAMINS. The principal sources of these substances are dairy products, fats, vegetables, and fruits.

WATER in appreciable amounts is also essential in the daily diet.

Carbohydrates and fats furnish energy and heat. Proteins are essential to the construction of body tissue, for the repair of worn-out cells, and are also sources of energy. Mineral salts are important constituents of the body and are necessary to the maintenance of health. Vitamins, of which there are at least five, designated by the letters A, B, C, D, and E, are essential for the utilization of foods both for maintenance and growth and afford protection against scurvy, rickets, and other 'insufficiency' diseases.

The fuel or energy value of food is calculated from its power to produce heat when burned. The unit of measurement in dietetics is the Calorie, the amount of heat required to raise the temperature of a litre of water 1° C., or a pound of water (one pint) 4° F. In spite of recent discoveries that the value of some of the essential food elements, i.e., the vitamins and mineral salts, cannot be expressed in energy or heat units, 'the fact is that the appreciation of the calorie idea in nutrition has not gone out but, on the contrary, has become a permanent part of everyday science.'[1]

[1] *Journal of the American Medical Association*, October 24, 1925.

The importance of a plentiful source of Calories at low cost is stressed when we consider the daily needs of individuals of varied age and occupation:

DAILY REQUIREMENT [1]

Children

	CALORIES
Boys 6–7 years	1400–1700
Girls 6–7 years	1300–1600
Boys 15–16 years	2700–3300
Girls 15–16 years	2150–2450

Adults

	CALORIES PER POUND OF BODY WEIGHT	MAN WEIGHING 150 POUNDS
Sedentary occupation	14–16	2000–2400
Light physical exercise	16–18	2400–2700
Moderate exercise	18–20	2700–3000
Hard labor (muscular)	20–23	3000–3500

In general terms, therefore, it may be stated that a healthy man weighing 150 pounds requires daily in a temperate climate and in the performance of ordinary work, a food intake equivalent approximately to 3000 Calories. It is now generally recommended that 10 to 15 per cent of the Calorie requirements should be provided by proteins, and the rest by carbohydrates and fats.

The desirability of reducing the protein content of the diet was first suggested by Professor Chittenden, of Yale University, since the members of his large group of men under close observation were well-nourished and in perfect health on a daily protein

[1] Rose, M. S.: *Laboratory Handbook of Dietetics* (New York, Macmillan, 1925).

ration of two ounces or even less. These results were later confirmed by the war-time experiments in food economics of Benedict and others in 1917. Drs. Chace and Rose, as a result of their tests, stated:[1] 'This means that a mature man of average size need not consume more than 40 grams of protein a day and under stress of circumstances can get along on less.'

These experiments, which suggest the desirability of reducing proteins in the interest of health and economy, emphasize also the relative importance of selected carbohydrate foods. It is evident that in any balanced diet the energy-giving foods, such as carbohydrates, must form the larger part.

The Banana an Important Staple Food

The banana, with its near relative, the plantain, constitutes an important source of carbohydrate food for enormous numbers of people in many parts of the tropics.[2]

Estimates made by various authorities show that

[1] Chace, Arthur F., and Rose, Anton R.: 'Dietetic Treatment of Nephritis,' *Journal of the American Medical Association*, vol. 69 (1917), p. 440.

[2] Fawcett, *op. cit.*, p. 109, states: Dr. William Wright, in his 'Account of the Medicinal Plants Growing in Jamaica' (*London Medical Journal*, vol. 8, 1787, p. 272), wrote as follows, more than 120 years ago, of the plantain and banana: 'The banana is never eaten green; but when ripe it is very agreeable, either eaten raw or fried in slices as fritters. Plantains and bananas are eaten by all ranks of people in Jamaica; and but for the plantains the island would scarcely be habitable, as no species of provision could supply their place. Even flour, or bread itself, would be less agreeable, and less able to support the laborious negro, so as to enable him to do his business, or to keep in health.'

the amount of food material produced per acre in the cultivation of bananas exceeds that of any other crop.

The creation from tropical jungles in widely separated areas, of enormous plantations, protected by constant and extensive sanitation; the construction of railroads and docks; and the development of adequate steamship facilities of specialized types, have made the banana a staple food, available throughout the year for people of the temperate zones.

J. Russell Smith, Professor of Economic Geography at Columbia University, in his valuable book, 'The World's Food Resources,' [1] says:

> The possibilities of the banana as a food resource for the temperate zone have only begun to be developed.

The importance of the banana has been recognized by Professor Samuel C. Prescott, of the Massachusetts Institute of Technology:[2]

> The fact that bananas may be obtained in abundance throughout the year, that they may be shipped for long distances under suitable conditions, without being impaired in any way, that they may be used as a fruit or as a vegetable, cooked or raw, in their normal form or dried or powdered, shows clearly that in this remarkable fruit we have an adjunct to our dietary which should not be overlooked.

Many other leading authorities have agreed with these statements. The remarks of Sir James Crich-

[1] (New York, Holt, 1919), p. 170.

[2] 'The Banana: A Food of Exceptional Value,' *Scientific Monthly*, vol. 6 (1918), p. 74.

ton-Browne, the famous British physician and Fellow of Royal Society, contained in a letter to W. Fawcett, dated December, 1924, are typical and significant:[1]

> Extended experience of the banana has deepened my conviction of its food value. It is a great boon to the masses of our people and while retaining its place on the dessert table of the rich, has found its way into the hands of the poor. Its portability, palatability, digestibility are immense advantages.

A still more recent tribute is found in an article on 'The Food Value of the Banana,' by Professor Walter H. Eddy, of Teachers College, Columbia University:[2]

> Few of the dietary contributions of Nature offer us more values with less danger to health than this common fruit.

Dr. G. Carroll Smith, author of 'What to Eat and Why,' states:[3]

> Until comparatively recent times considered as a luxury, the banana is now abundant, easily obtained and available to people of the temperate zones at moderate cost. In palatability and digestibility, qualities which are closely related, the banana has demonstrated its usefulness not only for adults but for children, and for the healthy individual as well as the convalescent. The cleanliness of the banana, protected in its unbroken skin from all contamination, is absolute.

The banana is, therefore, to be considered not

[1] Quoted in Fawcett, *op. cit.*, p. 108.
[2] A popular article in *Modern Priscilla* (March, 1926).
[3] Foreword to *The Food Value of the Banana.* 2d. ed. [Skinner, Sherman and Esselin, compilers] (Boston, Leonard, 1926).

a luxury, but a valuable addition to the standard food supply. Its greater utilization as a food is an important factor in the solution of the economic problem of supplying the increasing world population with a staple food, obtainable at all seasons and at low cost.

The Banana Meets the Test

Laboratory experiments and actual food tests by dietitians have established the following facts:

The banana is one of the most important carbohydrate heat- or energy-producing foods and is a good source of mineral salts and vitamins; it contains some protein and fat, but in small quantities. Measured in terms of food value, the banana costs on an average throughout the year less than any of the other fresh fruits and most of the common vegetables.

Many analyses of the banana have been made by eminent investigators. In Bulletin 28 of the United States Department of Agriculture,[1] the figures of Atwater and Bryant show the following interesting comparison of the edible portion of the banana with that of the potato:

	Banana (per cent)	Potato (per cent)
Water	75.3	78.3
Protein	1.3	2.2
Fat	0.6	0.1
Carbohydrates	22.0	18.4
Mineral matter	0.8	1.0
Calories per pound	460	385

[1] (Rev. ed., Washington, Government Printing Office, 1906), pp. 68–71.

It will thus be seen that in fuel or energy value (carbohydrates) the banana exceeds the potato by about 20 per cent.

It is also of interest to compare the energy value of the banana, as presented in this bulletin, with that of other foods which are regarded as indispensable in a properly regulated diet, the figures in all cases referring only to edible portion:

	Calories per Pound
Fruits:	
Bananas	460
Grapes	450
Figs, fresh, ripe	380
Cherries	365
Apples	290
Oranges	240
Muskmelons	185
Strawberries	180
Vegetables:	
Fresh Lima beans	570
Green corn	470
Green peas	465
Parsnips	300
Onions	225
Beets	215
Squash	215
Carrots	210
String beans	195
Cabbage	145
Spinach	110
Asparagus	105
Milk and Cereals:	
Macaroni, cooked	415
Milk, whole	325
Boiled oatmeal	285
Meats:	
Round steak, medium fat	950
Round steak, very lean	540
Chicken, broilers, edible portion	505
Pickled tripe	270
Fish:	
Halibut	565
Bluefish	410
Lobster	390
Scallops	345
Haddock	335
Cod	325
Flounder	290
Clams, raw	240
Oysters, solids	230

An examination of this table shows that the banana exceeds in energy value many foods of different classes in almost daily use, such as whole

milk, boiled oatmeal, fruits, most vegetables, and fish.

The following table compiled by Skinner, Sherman, and Esselen, Consulting Chemists, Boston, gives the comparative costs of a variety of foods, both of animal and vegetable origin, based on Calorie value. On a cost basis, dry cereals are in a class by themselves. Market prices of many other foods, such as eggs, butter, and potatoes, are subject to great seasonal variation, in this respect differing from the price of bananas, which is fairly stable throughout the year. The costs per pound, shown in the first column, are the average retail prices prevailing during 1926 in fifty-one cities of the United States, as compiled monthly by the Bureau of Labor Statistics of the United States Department of Labor and published in the 'Monthly Labor Review,' February, 1927. The fuel values used for calculating the figures in the second and third columns were taken from 'The Chemistry of Food and Nutrition,' third edition, 1926, by H. C. Sherman:

	Cost per Pound as Purchased (in cents)	Cost of 100 Calories as Purchased (in cents)	Calories Purchased for Five Cents
Flour, wheat	6.0	0.4	1343
Rolled oats	9.1	0.5	996
Lard	21.9	0.5	932
Beans, dry white	9.3	0.6	842
Rice	11.6	0.7	686
Bread, white	9.4	0.8	628
Butter	53.1	1.5	329
Potatoes, white	4.9	1.6	308
Cheese	36.6	1.8	272
Milk, whole fresh	7.0	2.2	224

	Cost per Pound as Purchased (in cents)	Cost of 100 Calories as Purchased (in cents)	Calories Purchased for Five Cents
Beef, rib roast	30.3	2.4	208
*Bananas	8.2	2.8	177
Beef, chuck roast	22.5	2.8	177
Corn, canned	13.2	2.9	172
Onions	6.0	3.0	166
Pork chops	39.5	3.2	156
Lamb, hind quarter	39.0	4.1	122
Beef, sirloin steak	41.3	4.3	116
Cabbage	5.8	4.8	104
Ham, smoked	57.4	5.4	94
Eggs, strictly fresh	32.3	5.4	92
Beef, round, lean	35.6	5.5	91
Peas, canned	14.0	5.5	90
Oranges	10.1	6.0	84
Tomatoes, canned	9.7	9.4	53

* Calculated on the basis of 4.27 pounds to the dozen.

The outstanding fact which is revealed by a study of these figures is that, when *measured by food value*, the banana is cheaper than many common foods, being surpassed only by such concentrated foods as the dry cereals and beans, potatoes, the milk products, beef (rib roast), and lard.

Many of the common foods, before they can be eaten, must be cooked, which often results in a considerable loss of Calorie value. In comparison with these foods as actually eaten, the fully ripe banana ranks higher in food value than indicated by the above table and may equal or even surpass the concentrated foods.

Ripeness and Digestibility of the Banana

Any mistaken impression that bananas are diffi-

cult to digest is due to eating them before they are ripe. In this respect they do not differ from apples, pears, melons, or any other fruit which, if eaten in an unripe state, may cause digestive disturbance. When ripe or when cooked in the unripe state, the banana is easily digested and possesses great value in the diet of both young and old.

The banana is one of the few fruits that attain maximum flavor and food value when harvested green and allowed to ripen off the tree. As shipped from the tropics and discharged from the steamship, the fruit is green and hard, and its carbohydrate content is almost entirely starch.

During the process of ripening, the starch in the banana gradually becomes converted into easily digested sugars. The peel first becomes yellow except for a green tip. At this stage only a portion of the starch has changed to sugar. In this 'partially ripe' condition bananas should not be eaten raw, but may be cooked in many tempting ways and used as a vegetable or a dessert.

In the next stage, called the 'yellow-ripe,' when all trace of green has disappeared, by far the larger part of the starch has become sugar. The pulp begins to soften and the peel is readily removed. The fruit now has a delicious flavor, and can be easily digested. It is recognized by most people that further ripening improves the banana and that it is at its best when the peel has become flecked or spotted with brown. Then practically all the starch is converted into sugars, the flavor developed

to its highest delicacy, and the fruit most digestible.

In the process of digestion starch is converted into sugar. When foods containing starch are subjected to heat, the starch grains are broken up, with the result that the starch is liberated from the cells and the digestive juices can get at it more effectively. Cooking of typical starchy foods, such as the raw potato and the unripe banana, accomplishes this purpose.

Bananas, until fully ripe, should be kept at a moderate room temperature — *not in the ice chest*, a mistake commonly made — as cold prevents proper ripening and the development of the fine natural flavor.

Food experiments by dietitians have shown that the carbohydrates of the ripe banana are in simpler form and consequently are more readily digested and assimilated than those of cereals or potatoes, and that digestibility is directly proportional to the ripeness of the fruit.

Dr. Arnold Lorand, of Carlsbad, states: [1]

> There is probably no more nourishing fruit, or one whose cultivation would be more valuable for mankind, than the banana. As far as its digestibility is concerned, I have personally observed that when eating a perfectly ripe banana, it will almost melt in the mouth, when simply turned around several times, without any actual mastication.

Careful studies on the digestibility of the banana

[1] *Health and Longevity through Rational Diet* (Philadelphia, Davis, 1913), p. 299.

have been made by Drs. Victor C. Myers and Anton R. Rose.[1] In their many practical tests they noted no discomfort where the fruit was ripe when eaten. The carbohydrates were well absorbed from the intestine and no ill effects were observed even after the consumption of large quantities of the ripe fruit for several days.

Composition of the Ripe Banana

The peel forms about 35 per cent and the edible portion, or pulp, about 65 per cent of the fruit.

A summary of numerous analyses of the edible portions of the ripe banana by eminent authorities, presents a picture somewhat as follows:

> The pulp contains about 72–76 per cent of water; 15–20 per cent of total sugars, of which sucrose (cane sugar) may be as little as 2 per cent or as much as 14 per cent, and the remainder, 'invert sugar,' i.e., a mixture of equal parts of dextrose and levulose; from 7 per cent of starch in the yellow ripe banana to practically no starch in the fully ripe fruit flecked with brown; 1.3 per cent of protein or nitrogenous matter; about 0.3–0.6 per cent of fat; about 0.3–1.0 per cent of crude fibre or cellulose; and about 0.7–1.2 per cent of ash.
>
> In addition, the pulp contains small amounts, usually less than 1 per cent of various substances, the most important of which are fruit acids and esters, which largely determine the flavor and aroma of the fruit.

[1] 'The Nutritional Value of the Banana,' *Journal of the American Medical Association*, vol. 68 (1917), pp. 1022–24.

The Banana and Meat Foods Compared

A comparison of the food values of the banana and meats should be made only with the realization that they belong in different classes.

The banana is mainly a carbohydrate or energy-producing food, while meats are essentially protein foods, adapted to the building of tissue.

Professor Samuel C. Prescott, in his paper previously quoted, states:

> The banana contains all the classes of food materials required for the animal body. Although the amounts of protein and fat are too low to constitute a perfectly balanced ration, the combination of banana with milk, in proper proportion, or its utilization as a vegetable to supplement a diet containing a small amount of meat, will produce a ration which is ample to take care of the body needs. Meats are essentially protein foods, and as such are more adapted to the development of tissue than to the quick production of heat, while the banana, on the other hand, is less a tissue-forming substance, but is incomparably more effective in supplying the heat-giving materials. In a crude way we might say that the proteins are the foods which make good the losses due to wear and tear in the machinery of the body, while the carbohydrates are the foods which keep the machinery in motion and do work.

It is undesirable and uneconomical to have too much protein in the diet. Only the nitrogen needed for the repair and building of tissue is utilized, the surplus being excreted. There is no storage of protein against a future shortage, as in the case of

fat. The importance of this fact is recognized as soon as, for any reason, elimination is impaired.

Even in a restricted meat diet, fats are present in limited amounts; and though fats and carbohydrates are more or less interchangeable as sources of heat and energy, fats can be utilized only in the presence of carbohydrates and the latter are therefore necessary in every form of restricted diet.

The Banana and Mineral Salts

In any consideration of foods, the importance of the inorganic constituents, commonly known as mineral salts, should not be overlooked. While only relatively small quantities are necessary, they are essential to the body needs. Phosphorus is widely distributed in the body, and is as essential to the living cells as are the proteins, while calcium and iron are necessary for the development of bone and blood.

The banana contains appreciable quantities of these valuable mineral salts, consisting principally of the phosphates, sulphates, and chlorides of potassium, sodium, magnesium, and calcium, as well as significant amounts of iron.

The Bureau of Public Health Education of the New York City Department of Health, in Bulletin no. 7 (1917), states:

> The onion, like most green vegetables, is of value in the diet chiefly for the mineral salts which it contains. It is these and not its protein that make it a valuable addition to bread and meat. Bread and

cereals and meat are described by the chemist as having an excess of acid-forming over base-forming mineral matters. Green fruits and vegetables are of the opposite character, having an excess of base-forming minerals. A proper balance of these two classes of minerals in the diet is essential to health. There is danger at the present time, when vegetables are unusually costly, that the health of the community may suffer from a deficiency of base-forming minerals in the diet. It is important, therefore, to call attention to the fact that apples, bananas, and oranges, which have not greatly advanced in price, may be used as substitutes for vegetables. They contain the same mineral matter in varying proportions. Apples, bananas and oranges all surpass onions in their excess of base-forming minerals.

The table below shows the amount of the three important inorganic elements found in a few of our most common fruits:

	Grams per 100 Grams Edible Substance		
	Phosphorus	Calcium	Iron
Bananas	0.031	0.009	0.0006
Apples	0.012	0.007	0.0003
Oranges	0.021	0.045	0.0002

Bananas then not only supply at a low cost the principal nutrient mineral elements, but in such proportions that the fruit when eaten has an alkaline effect, and thus provides a corrective for the acid tendency of many of our more common foodstuffs.

It is of interest that both the banana and the potato yield an alkaline ash and are therefore antagonistic to the development of an acidosis.[1]

[1] Myers, Victor C., and Rose, Anton R., *op. cit.*, p. 1023.

In a recent article on Acidosis, Dr. W. D. Sansum states:[1]

> In preventing or curing an acidosis, oranges together with apples, muskmelons, bananas, and potatoes are very efficient. Too much cannot be said about the value of fruits in a diet, for in addition to their alkalinizing effect, they have a high food value and contain an abundance of the minerals and vitamins.

The Banana a Good Source of Vitamins

Since 1906 dietitians have learned that a selection of foodstuffs supplying nutrients in proper kind and amount may still fail to nourish unless there be present definite though small amounts of substances now known as 'vitamins.' The daily requirements of these substances and the amounts in foods are so small that as yet there has been devised no unit of weight with which to measure them.

Vitamins have not yet been isolated, but modern science has found a way to express the adequacy of a food as a source of these factors and has taught us that there are at least five which must be in the daily diet or illness of one sort or another follows. At present these factors are designated by letters and are recognized as vitamins A, B, C, D, and E, each with a different protective function. The importance of this protection is emphasized by McCollum and Simmonds:[2]

[1] 'Acidosis — How Foods may be Effectively Used in its Prevention and Cure, with Menus,' *Food Facts*, vol. 3, no. 1 (May, 1927), p. 12.

[2] *Op. cit.*, p. 539.

> We are taking too little of the protective foods, milk, the leafy vegetables and fresh fruits and a movement toward stimulating the consumption of these classes of foods would go far toward effecting that improvement in our national health standards, for which the many agencies concerned with the public health are seeking.

Vitamins are indispensable for growth and maintenance of health. They are unequally distributed in foodstuffs and their principal sources are dairy products, fats, vegetables, and fruits. Vitamin A insures protection against eye-disease; vitamin B, against beri-beri; vitamin C, against scurvy; vitamin D is the anti-rachitic factor; and vitamin E, the anti-sterility factor.

The vitamin value of the banana had been only partially investigated in the years prior to 1925. During that year quantitative studies were carried out in the Physiological Chemistry Laboratory of Teachers College, Columbia University, and established the following facts:[1]

Although it contains a much higher proportion of water, the banana, in vitamin A, is about one twentieth the value of pure butter and equal to vegetables fairly rich in this vitamin, for example, green peas.

Of vitamin B, the banana has been found to be a good source, and in this respect is, weight for weight, the equivalent of tomato juice and nearly equal to a good quality of milk.

[1] *Cf.* Eddy, W. H.: 'The Vitamin Content of Foodstuffs,' *American Journal of Public Health* (February, 1926).

In vitamin C, the anti-scorbutic vitamin, the banana has been found to be nearly twice as rich as previously reported, and to compare well with oranges and tomatoes.

In October, 1926, Professor Walter H. Eddy of Columbia University reported further: [1]

> From the various tests now available it seems safe to class the banana as an excellent source of vitamins A and C; a good source of vitamin B; deficient in vitamin D and not lacking in vitamin E. Its potency in C, the availability and the relative cheapness of the fruit, makes it a competitor with tomato juice and orange juice for use in infant feeding on vitamin basis alone. Its use, will not, however, eliminate the necessity for cod-liver oil or sunlight to avoid incidence of rickets.

Emphasizing the relative importance of vitamin A, Professor H. C. Sherman, of Columbia University states: [2]

> Thus there is abundant evidence that a shortage of vitamin A in the food results, sooner or later, in a widespread weakening of the tissues and functions of the body. It seems likely that vitamin A plays the double rôle of a tissue constituent and also of a 'regulatory' substance concerned with the maintenance of normal conditions and the control of nutritional processes. . . .
>
> Vitamin A thus becomes a very important factor in food values, and it may be said in conclusion that this vitamin should always be held clearly and pro-

[1] 'The Place of the Banana in the Diet,' *American Journal of Public Health*, vol. 17 (January, 1927), pp. 31–32.

[2] 'The Vitamins,' *Journal of Chemical Education*, vol. 4, no. 1 (January, 1927), pp. 68–70.

minently in mind in any comprehensive consideration of food values or of nutritive requirements.

Therapeutic Value

Not only has the banana an important place in the dietary of persons in normal health, but it has been found to be of value in the treatment of certain diseases. In his paper, 'The Place of the Banana in the Diet,' read before the American Public Health Association at Buffalo, on October 13, 1926, Dr. Eddy reports:

> Through the courtesy of Dr. Joseph Johnston, of the Department of Pediatrics, Harvard Medical School, Children's Hospital, Boston, we submit herewith X-ray and other data pertaining to a case of infantile scurvy treated and cured by a diet consisting solely of bananas and milk. The baby was 8 months old and weighed 12 pounds. A banana milk diet was made by whipping into 570 c.c. of milk 200 g. of ripe raw banana. The baby was fed 120 c.c. of this mixture every 4 hours. No other food or anti-scorbutic was necessary. The child tolerated the mixture without any signs of digestive disturbance, gained in weight and recovered from scurvy. In this case the banana not only provided the anti-scorbutic but also the necessary carbohydrate to modify the milk suitably. The results confirm the conclusion stated by Sugiura and Benedict [1] in 1919, viz.:
>
> 'Our experiments suggest that a combination of bananas and milk, in proper proportion, constitutes a complete food.'

[1] Sugiura, K., and Benedict, S. R.: 'The Nutritive Value of the Banana,' *Journal of Biological Chemistry*, vol. 36 (1918), pp. 171–89; vol. 40 (1919), pp. 449–68. (Statement quoted will be found on p. 468.)

In the treatment of cases where the protein intake of the dietary must be restricted, inclusion of bananas in the ration of patients suffering from nephritis (inflammation of the kidney), for example, has been found to be of distinct advantage. Drs. Chace and Rose, in their discussion of this disease state:[1]

> In interstitial nephritis the most characteristic phenomenon is the lowered permeability of the kidney for the nitrogenous constituents of the urine. The more protein there is in the diet, the more these substances accumulate in the blood, overtaxing the kidney and causing intoxication of the whole organism. Hence, the first dietary consideration in these cases is limitation of the nitrogen intake.

Drs. Myers and Rose have found the banana a means of supplying calories for nephritic patients:[2]

> The banana would appear to be a particularly valuable food to employ in the dietetic treatment of nephritic patients with nitrogen retention. Very satisfactory results have been obtained in the rather mild cases of nephritis here reported. So long as the patients exhibit no distaste for the fruit, there would seem to be no reason why bananas should not be employed in considerable quantity.

Dr. Sidney V. Haas, of New York, has used bananas extensively in the treatment of celiac disease (chronic intestinal indigestion), one of the most troublesome disturbances of nutrition of late in-

[1] Chace, Arthur F., and Rose, Anton R., *op. cit*, p. 440.
[2] *Op. cit*, p. 1024.

fancy and early childhood.[1] This disease is characterized by inability to utilize properly the carbohydrates and fats. In his dietetic treatment of this disease, Dr. Haas has rigorously avoided carbohydrates, except those of the extremely ripe banana, and small quantities which occur in certain milk products. With these exceptions it has been impossible, in severe cases, to give any carbohydrate without producing unfavorable symptoms; the ripe banana, however, is not only well tolerated, but rapidly changes the entire clinical picture of disease to one of well-being.

An excellent confirmation of Haas's work is given in a paper by Dr. Henry Eugene Irish, of Chicago, entitled 'A Case of Celiac Disease with "Banana Treatment:"'[2]

> This case of celiac disease is reported because the weight was nearly doubled after a year's treatment as an outpatient on a high protein diet, with low fat and carbohydrate largely in the form of raw bananas.
>
> In this case reported the banana pulp was obtained from ripe fruit as evidenced by golden yellow color with black spots on the skin. They were freed from any dark spots on the pulp and were passed through a potato ricer and fed with a spoon. The amount fed at first was a half-ounce daily and, being tolerated well, was rapidly increased to three whole bananas in a day. . . . No adequate explanation has been ad-

[1] Haas, Sidney V.: 'The Value of the Banana in the Treatment of Celiac Disease,' *American Journal of Diseases of Children*, vol. 28 (1924), pp. 421–37.

[2] *Archives of Pediatrics*, vol. 43 (1926), p. 533.

vanced to show why banana sucrose is tolerated when cane or beet sucrose must be prohibited.

This patient, a girl 4½ years old, weighing 19½ pounds, was placed on this dietetic treatment October 1, 1924. The gain in weight for six months was 7 pounds, 37 per cent of the presentation deficiency — and for twelve months 11½ pounds. At the end of the year her weight was 31 pounds. The gain in height was 4 inches and she was slightly overweight for her height.

Since in celiac disease children will not tolerate any of the usual forms of carbohydrate or fat, it has been necessary heretofore to provide nourishment mainly in the form of protein as the only means of keeping them alive. Dr. Haas's work showed that banana carbohydrate was tolerated by these cases when other forms of carbohydrate were not. Dr. Irish has found the same result. He has combined a high protein and low fat diet with banana and found the child to tolerate it satisfactorily. Dr. Irish states in conclusion:

> In the author's case the bananas were taken eagerly, were a means of breaking the monotony of diet and did not interfere with the restoration of normal stools or the excellent progress made by the child.

Bananas in the Children's Dietary

As food for children, ripe bananas are especially good, because they are nutritious and easily assimilated. The flavor is so delicious that a child will eat them with enjoyment in place of sweets. Ripe bananas as well as the cooked unripe fruit are being

used more and more in the dietary of young children.

Among the dietitians who have given careful study to bananas as a food for children are Drs. Pease and Rose of the New York Post-Graduate Medical School and Hospital. The following quotation [1] summarizes in part the conclusions of their clinical experience:

> The banana is a useful fruit that can with profit enter liberally into the child's dietary, provided it is fully ripe, or well cooked. If eaten baked in the yellow stage of ripeness, or if eaten raw when fully ripe, the banana makes a delightful and highly nutritious article of food. Its composition does not warrant the use of bananas as the main component of the child's dietary, but it can compete well with other fruits, and is decidedly to be preferred to candies. . . . The banana ought not to be eaten raw until after the brown spots begin to appear. It is at this stage a full golden yellow, and at its most attractive appearance. A completely browned skin is not in itself a sign of over-ripeness and such fruit should be judged by the texture of the pulp. The brown color of the peel, however, should not be confused with the darkening due to bruises. . . . The banana properly handled and allowed to ripen to its most beautiful color and texture is a wholesome food, uncontaminated by dirt and pathogenic germs even if purchased from the push cart in our congested streets.

A communication to the author from Dr. P. G. Shipley, Associate Professor of Pediatrics of the Johns Hopkins University and Associate Attending Pediatrist of the Johns Hopkins Hospital, states:

[1] 'The Banana as a Food for Children,' *American Journal of Diseases of Children*, vol. 14 (November, 1917) p. 390.

We use the raw banana extensively in the dietary of children and we also prescribe it in appropriate quantities in the treatment of celiac disease or chronic intestinal indigestion. It is a very valuable article of food.

In an address before the Orleans Parish Medical Society in New Orleans, May 9, 1927, on 'The Banana as a Food for Infants and Children,' Dr. L. von Meysenbug, Instructor in Pediatrics, Tulane University, stated:[1]

During the past year I have fed banana to ninety infants ranging in ages from four months to two years. All of these were well infants, though many had not gained satisfactorily and several suffered from marked constipation. Various methods of preparing the fruit were tried out. These included mashing the banana with a spoon, mashing and pressing them through a wire sieve, baking with and without the skin, and emulsifying the mashed pulp in the formula. I found the most satisfactory of these to be the fruit pressed through the sieve.

It is necessary to explain in detail to the mother what is meant by a ripe banana. The skin must be entirely yellow, without green tips, and there should be brown or black spots. An all-brown skin banana may be used if the pulp is not mushy or brown. Where the pulp is brown and has a transparent appearance, fermentation is taking place and such a fruit should be discarded. For baking, the banana need not be entirely ripe. It is further necessary to explain to the parent why the traditional fear of the banana for the young child is without foundation; that it is not indigestible if ripe and suitably pre-

[1] In press with *New Orleans Medical and Surgical Journal.*

pared. I have met with only one refusal to give it.

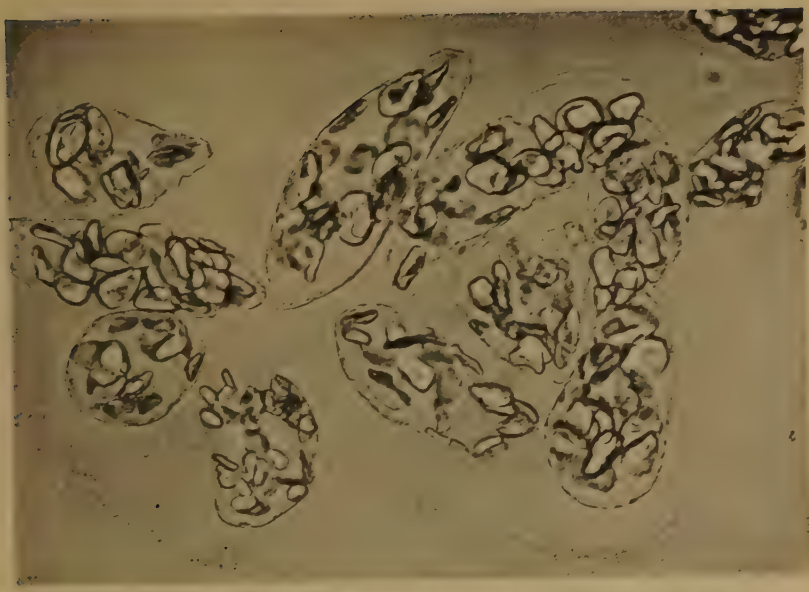
My records show that of these ninety babies to whom banana was given, only two could not tolerate it because of its laxative effect.

When beginning the banana feeding to a young infant of four or five months, only one teaspoonful of the mashed pulp is given for the first few days. If it is well borne it is increased cautiously up to about six or eight teaspoonfuls. Very seldom does the infant refuse to take it — for the most part they cry for more. It is usually given at the 12 or 2 o'clock afternoon feeding hour, before the breast or bottle. If the infant refuses to take the banana the first day, it is offered again on subsequent days and the dislike invariably changes to a desire for more. I have no record of any baby vomiting the banana.

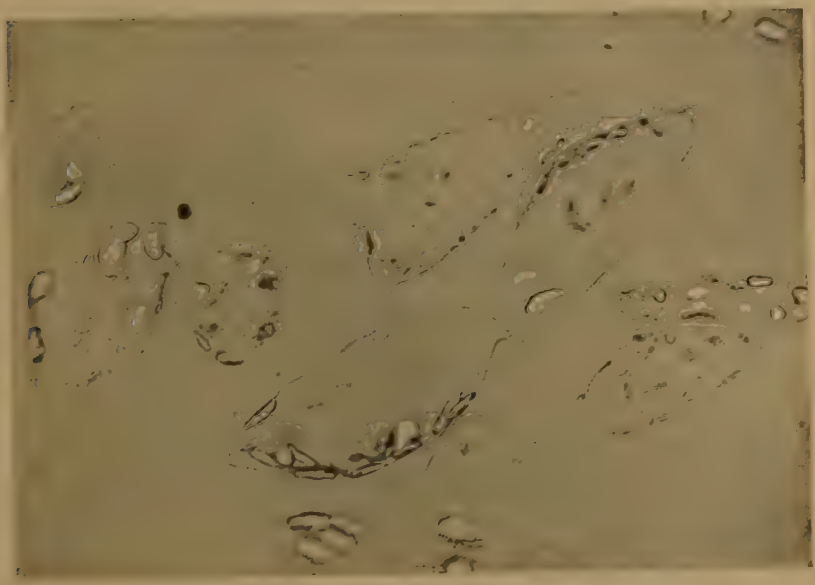
It is in the constipated babies that some interesting results were obtained. Some were completely cured, others greatly benefited. A single instance to illustrate:

Baby G. L., age 6 months, weighing 14 lbs. 10 oz., was breast-fed from birth. She was normal except that she was underweight. Orange juice had been begun at one month and cod-liver oil one half teaspoonful twice daily at six weeks. The mother stated that she thought she had sufficient milk, as she felt the breasts fill, become tense, and they leaked. However, the fact that the baby was underweight and markedly constipated indicated that her supply must have been deficient quantitatively as well as qualitatively. Banana pap was begun at 6½ months in teaspoonful daily amount. On the third day the baby had its first natural bowel movement in two months and continued to have a daily action. Complemental bottle feedings brought about a good gain in weight.

That banana may cause rapid gain in weight when



Green Banana. All the cells full of starch and all the grains entire



Fully ripe Banana. Most cells now entirely free from starch

PHOTOMICROGRAPHS OF SECTIONS OF BANANA FRUIT PULP, SHOWING CHANGE OF STARCH TO SUGAR IN THE RIPENING PROCESS

(Professor Francis E. Lloyd, McGill University)

A GROUP OF DR. HILBERT DAY'S UNDERNOURISHED CLASS AT END OF SESSION

other food is not sufficient is shown by the following case:

Baby J. S., age 8½ months, weighing 16 lbs. 14 oz. He had been under observation since two months of age, at which time his weight was 9 lbs. 6 oz. He was breast-fed exclusively up to four months, when complementary feeding became necessary because of stationary weight and constant crying. His gain from then on was only fair, averaging not more than 10–12 oz. per month. At 8½ months banana pap was started and increased rapidly, so that at 9 months he was getting one whole medium-sized banana daily. His bowels were regular and he took the fruit with zest. In two weeks he had gained one pound, no other changes having been made in his diet.

The character of the stools changes when banana is given. They assume a grayish color, are soft in consistency, and show small grayish black threads which are in no way harmful.

In 'Hygeia' of May, 1927, Dr. Hilbert F. Day, of the Harvard Medical School Faculty, and President of the Cambridge Anti-Tuberculosis Association, has given the record of a summer class of underweight school children, treated for eight weeks by sunlight, fresh air, exercise, with special attention to diet in which bananas and milk were an important item. Reporting the excellent results, Dr. Day, under the caption 'Bananas and Milk are Good Team,' says:[1]

> This indicates an ideally balanced and highly nutritional ration.

For undernourished children in many school

[1] Sunshine Camp in Cambridge, *Hygeia*, vol. 5 (May, 1927), pp. 248–51.

classes, tuberculosis camps, and hospitals, ripe bananas and milk are now a standard diet.

The Banana a Naturally Sealed Package

Unlike many fruits, the banana reaches the consumer in a germ-proof package sealed by Nature. The thick, enveloping peel, largely fibrous in its structure, and with compact outer surface, effectively protects the edible portion, i.e., the pulp, from bacteria, molds, or other forms of contamination. Furthermore, the pulp is peculiarly immune from insect pests; a worm-eaten banana is unknown.

Many Ways of Using Bananas

Bananas have a place in the menu of virtually every meal and can be prepared and served in many tempting ways. For breakfast the fresh, ripe fruit is eaten sliced in milk or cream, with or without cereals. Partially ripe, it may be cooked in many ways and served as a vegetable; in the tropics it is often so used and makes an excellent substitute for the potato. As an entrée, banana fritters are especially pleasing. To fruit cocktails and the fruit salads, ripe bananas give not only flavor but substantial food value, while for desserts, served in many attractive ways — for example, in gelatine, custard, ice-cream, or in shortcake or pie — they are delicious and wholesome. Bananas sliced with other fruits, especially with apples, oranges, or grapefruit, make a very desirable and appetizing dish. As a fresh fruit, eaten alone or in combination with other

fruits and for salads and desserts, the sugary, ripe banana should always be used.

A salad of juicy fruits, in which bananas are used to furnish the carbohydrates and nuts the protein content, constitutes a dish of well-balanced nutrients.

The banana also fills an important place in the laborer's dinner-pail, the children's lunch-box, the school and factory cafeteria, and the picnic-hamper.

Summary

The banana is a delicious fruit and one of the most important energy-producing foods. When used with milk, its carbohydrate content makes an ideally balanced ration; when combined with other fresh fruits and the leafy vegetables, it supplies the needed Calories.

Its small quantity of protein and fat enables the dietitian, as is often necessary, to increase Calorie values without appreciably adding to the protein content.

As a protective food the banana is an excellent source of vitamins A and C and a good source of vitamin B; it also has an appreciable quantity of the essential mineral salts.

It is a nutritious, natural food requiring no, or only the simplest, preparation. It may be served in many ways and its flavor blends agreeably with those of other fruits.

Measured in terms of food value, the banana costs on an average throughout the year less than

any of the other fresh fruits and most of the common vegetables.

Tests by eminent dietitians have shown that in the fully ripe condition, or when cooked in the unripe state, the banana is easily digestible and possesses great food value in the dietary of both young and old.

In the treatment of certain diseases — chronic intestinal indigestion in children (celiac disease), scurvy, and inflammation of the kidney (nephritis) — the banana has proved of great value.

With proper care it may be shipped to distant points without deterioration. It reaches the consumer in a germ-proof package.

Since cold prevents proper ripening and the development of the fine natural flavor, bananas should not be kept in the ice-box unless they are fully ripe.

The banana is obtainable in abundance at all seasons. In the winter months especially it provides an inexpensive food particularly needed in the diet often too low in fresh fruits and green vegetables.

All these facts show clearly that this remarkable fruit is a valuable addition to our staple food supply.

Reference Table of Calorie Values

For the benefit of dietitians and others interested in well-balanced menus, the following reference table is given, comparing the food values of the banana and other foods in common use:[1]

[1] Locke, Edwin A.: *Food Values* (New York, Appleton, 1911), pp. 33–36.

Food	Quantity	Calorie Value of Edible Portions			
		Carbohydrates	Fats	Proteins	Total
Fruits:					
Banana	Av. size	113.7	7.3	6.4	127
Orange	Av. size	87.1	2.3	6.2	96
Apple	Av. size	66.4	4.2	1.8	72
Vegetables:					
Potato, white, boiled	Med. size	128.5	1.4	15.4	145
Green peas	3 h. tbsp.*	55.1	29.1	25.3	110
Squash	2 h. tbsp.	55.8	7.6	5.6	69
Dairy Products and Eggs:					
Milk, whole	1 glass	45.1	81.8	29.8	157
Butter	1 ball	....	118.6	0.6	119
Cheese, Swiss	Av. helping	1.1	64.9	22.6	89
Egg, boiled	1 egg	....	55.8	27.1	83
Cereals and Bread:					
Rice, boiled	1 h. tbsp.	100.0	0.9	11.5	112
Oatmeal, boiled	2 h. tbsp.	47.2	4.7	11.5	63
Shredded wheat	1 biscuit	92.6	3.8	12.5	109
Bread, whole wheat	1 slice	85.6	3.5	16.7	106
Meats:					
Steak, round, lean	Av. helping	....	71.6	113.2	185
Chicken, roast	Av. helping	8.6	40.9	131.6	181
Fish:					
Cod	Av. helping	6.5	2.5	88.9	98
Halibut	Av. helping	....	37.6	83.4	121
Lobster	Av. helping	1.7	17.6	70.6	90

* Heaping tablespoonfuls.

CHAPTER IX

BY-PRODUCTS OF THE BANANA

VARIOUS attempts have been made to secure by-products from the edible banana plant and fruit, as, for example, fibre from the tree and leaves, and 'figs,' flour, vinegar, and alcohol from the fruit. The only attempt thus far commercially successful is the partial drying of the fruit (banana 'figs'), which is exported in a small way principally to Europe.

It is of interest to note that the existing literature cites several instances where the natives in certain parts of Africa and the Far East, who subsist largely on bananas, make use of the fibre for thatching their huts, for hammocks, for baskets, and in various other ways. Notwithstanding this and the further fact that the Manila hemp is a member of the *Musa* family, the prospects for developing any commercial use of the fibre from the plant of the edible banana are doubtful, as the fibre, both from the tree and leaves, is of an inferior quality and of low yield. On account of the great fertilizing value of the banana plant, which is cut down and left to decay and form humus after the fruit is harvested, the commercial utilization of banana fibre is not possible unless fertilizers are heavily used on the plantation, which fact has thus far rendered the undertaking unprofitable.

More or less has been written on the subject of

banana and plantain flour, which is very nutritious and easily digested. It is made from green bananas or plantains. The peeled fruit is dried and ground, the water content being thus reduced to approximately 10 to 15 per cent and the other ingredients concentrated. The product is variously known as 'banana flour,' 'banana meal,' 'banana powder,' 'Pisang starch,' 'plantain flour' or 'meal.' It is as important in the diet of some tropical regions as oatmeal, wheat, farina, and cornmeal are in Northern countries.

From analyses made by recognized authorities, the average composition of banana flour appears to be about 12.6 per cent water, 3.4 per cent protein, 0.8 per cent fat, 78.9 per cent nitrogen-free substance, 1.3 per cent crude fibre, and 2.9 per cent ash. The nitrogen-free substance or total carbohydrates consists chiefly of starch (usually 45–75 per cent of the flour), a little (0–7 per cent) sugar, and the remainder dextrin, pectin, etc.

Sir Henry M. Stanley, the African explorer, in his account, 'In Darkest Africa,' refers to banana flour in the following terms:[1]

> The Awamba understood the art of drying bananas over wooden gratings for the purpose of making flour. . . . If only the virtues of the flour were publicly known, it is not to be doubted but it would largely be consumed in Europe. For infants, persons of delicate digestion, dyspeptics, and those suffering from temporary derangements of the

[1] (New York, Scribner, 1890), vol. 2, pp. 261–62.

stomach, the flour, properly prepared, would be of universal demand. During my two attacks of gastritis, a light gruel of this, mixed with milk, was the only matter that could be digested.

Thomas Heazle Parke, who went as medical officer on the Emin Pasha relief expedition with Stanley, makes this mention of him when he was suffering from a severe attack of acute gastritis:[1]

He eats porridge made with banana flour and milk. It is very light and digestible, and has more flavour than arrow-root. It is also very nutritious. We whites have good reason to know this fact now, as we have mostly lived on banana flour for the past two years.

'The Lancet' for October, 1903, states:

There can be no doubt of the nutritious character of banana flour, and the starch in it is particularly easy of solution and digestion in the alkaline digestive juices of the body. Banana flour is readily dissolved, for example, by the saliva.

The word 'flour' is really a misnomer for the powdered food, which more nearly resembles malted milk in appearance, food content, and usefulness. Powdered banana should not be considered as an ordinary flour, as its peculiar merits put it in a class by itself, distinct from common cereal flours. Its cost is also higher than that of cereal meal or flour. The reason for this is clear when we consider that in approximate figures a bunch of bananas is, by

[1] *My Personal Experiences in Equatorial Africa as Medical Officer of the Emin Pasha Relief Expedition* (London, n.d.), pp. 416–17.

weight, 10 per cent stalk, that the skin of each banana represents 35 per cent of its weight, and that the remaining pulp is 72 per cent water. At this rate it is readily figured that the average bunch of bananas will produce only from four to six pounds of flour.

Although until recent years powdered bananas have never been produced in a scientific and sanitary manner, this product is not a novelty, for banana and plantain meal has been made in a primitive way in the tropics for generations and used by the natives for infant feeding. For several years Canada and some of the European countries have recognized its dietary value in medical practice. It is one of the most digestible of the starchy foods and highly nutritious, hence suitable for invalids, convalescents, and those suffering from impaired digestion.

Research along various lines is being carried on by the larger banana companies, notably the United Fruit Company, to the end that useful by-products from the plant and the fruit may be commercially developed.

CHAPTER X

AN ANCIENT EMPIRE RETRIEVED

THE banana in its original home in southern Asia doubtless contributed largely to the sudden wealth which established the great cities of India and made possible the vast grotesque temples of the Buddhist religion, especially in the humid regions of that country, as well as the gigantic stone structures of Angkor Wat in Cambodia and of Boro Bodur in Java.

Introduced into the New World and cultivated in recent years on a large scale in the Caribbean countries, the banana is rapidly bringing about the rehabilitation of another ancient empire, which had also its great centres of population and magnificent temples, and flourished in the American tropics, centuries before Columbus.

To understand this strange repetition of history, it is necessary first of all to grasp the fact that the humid tropics are the most prolific lands in the world when full fertility can be evoked and the forces of disease, both of man and his domesticated plants and animals, can be routed or held in check. The Mayas of Central America, no less than the nations of southern Asia, accomplished ancient conquests of Nature in exuberant environments, albeit with different sets of domesticated plants, and both the Mayas and the Indonesian peoples felt, in the

end, the dire results of various tropical maladies. We now know that many animal and plant diseases are due to minute organisms which flourish, as most other living things flourish, when heat, sunlight, and rain are plentifully supplied. The parallelism between the ancient civilizations of southern Asia and Central America is instructive, letting us see more clearly what the future has in store now that science is able to correct some of the errors of the past.

Parallel Civilizations of Two Hemispheres

The rise of the priestly civilization of the Buddhists took place in northern India, with the famous Asoka as the first royal patron. In the first centuries of the Christian Era, the awakening and organizing force of Buddhist religion was directed toward previously unprogressive nations located in southern India, Burma, Cambodia, and other humid tropical areas of the East. As a result these peoples rose out of their lethargy and soon found that such food plants as rice, bananas, and breadfruit were a sufficient foundation for an improved social system and support of dense populations. This surplus food meant more hands to carve stone monuments and more feet to dance in the temple courts. The most brilliant period of the southern Asiatic civilization inspired by the teachings of the venerable Gautama, the Buddha, extended from the fifth to the eleventh centuries of the Christian Era, after which there was a relapse in several places due to the inroads of de-

bilitating diseases, to civil wars, and to various other causes of social decay.

In the New World the Mayas of Central America flourished on a still earlier historical level and developed a civilization entirely independent of the civilization of southern Asia in all essential matters. Yet their fate followed much the same course because it was conditioned by much the same factors in natural environment. And now comes modern man to try his hand at an immemorial game won and lost by ancient man. The material recapitulation remains the same except for a single new factor, namely, sanitation upon an ever-widening scale.

Imagine a nation of American Indians perceiving the economic possibilities of a difficult country — a country of forests, swamps, and heavy rains under the tropic sun — and achieving an enormous success in civilization, only to be beaten down and swept away by unseen forces utterly beyond control. Imagine the land returning to its wild state, a wide territory of jungles inhabited by wild beasts and small groups of wilder men. Imagine, after the lapse of many centuries, a new people filled with new hopes, possessing new facilities, with weapons against these unseen forces, entering this land and regaining its natural wealth.

Kipling's master-builder, who found the ruined footings of the palace that an earlier master had built, was able to read on the mouldering stone: 'After me cometh a builder. Tell him I, too, have

known.' That is the story of the empire of the Mayas and the new empire that American enterprise is building to-day on the western shores of the Caribbean Sea.

The opening-up of the humid lowlands of Central America by the new seaports, railroads, and banana plantations of the United Fruit Company is more than a story of business faith and commercial enterprise. It is a demonstration of empire rebuilding, in which health is an important factor. Here is a drama with a universal moral, for anthropology teaches that civilization is not the gift of a superior Nordic ancestry nor the product of a single race. Instead it grows almost inevitably for all tribes of men out of an abundant food supply. For an abundant food supply releases many persons from the pursuit of a mere livelihood to the pursuit of religion, art, and other luxuries of the heart and mind.

The Beginnings of the Mayas

When the Maya Indians about 1000 B.C. invaded the west lowlands of Central America with an agricultural programme formed around maize, beans, and pumpkins, they must have found it hard work to clear away the heavy forests with stone axes and to keep them cleared away. But the productivity of the new land gave them excess food beyond all expectation so that population increased rapidly.

Artists, high priests, and kings rose out of the blissful leisure. Men studied the stars. We know that the accurate recording of historical events be-

gan for this people on August 6, 613 B.C., and from names and symbols in their wonderful calendar we know that their life was already adjusted with scientific accuracy to the conditions of the humid tropics. Nor is there any direct evidence of any important changes in climate within this area.

The growth in wealth and population continued for many centuries. The earliest monument of the Mayas, with a contemporary date, was set up ninety-eight years before the birth of Christ. It ushered in seven fat centuries, during which time rich cities with gorgeous temples and public buildings rose and flourished over an extensive area in southern Mexico, northern Guatemala, and northern Honduras. The influence and example of the high civilization of the Mayas was felt far and wide and a series of other wet-land nations raised their standards in the territory to the north and south.

Why did these civilizations pass away, allowing the forests to close again over this land? Probably because some disease in epidemic intensity swept the cities. There are good reasons for believing that yellow fever — now fortunately eradicated from all that territory — had its origin among the Mayas, and that it led to the sudden abandonment of many great cities shortly after 600 A.D. This disease smouldered or flamed during the successive centuries down to our own times, and may have been the deciding factor in man's struggle with the overproductive environment of the humid tropics of Central America. Malarial fevers seem to have

been unknown, having been introduced from the Old World by the Spaniards.

Great Mayan Cities Abandoned

The first cataclysm swept clean the plains of Peten and the rich valley of the Usumacinta of all their towering cities. The dated history inscribed on monuments ends abruptly. The ancient capitals which we now call Quirigua and Copan, lying still farther to the south, in Guatemala and Honduras, were abandoned. Indeed, we may picture a panicky migration such as might be caused to-day by the appearance of a death-dealing epidemic.

We know that the Mayas re-formed their scattered ranks in northern Yucatan and were able to recover much of their earlier wealth in a new area. But the extent of the Second Empire was much less than that of the First Empire, and the population was also much less. Yellow fever doubtless continued to decimate the Mayan population, swinging back and forth across the area.

The lesser nations were not beaten down to the same extent by the scourge. The Chorotegas, 'those who were driven out,' adjoined the Mayas on the south and held the wet lands as far as Panama. The principal development of their arts took place between the time of the First and Second Empires of the Mayas, that is from 500 to 1300 A.D. They borrowed many ideas from the early Mayas, but never acquired their high science or great artistic skill, and at a later time they traded gold figurines to the

inhabitants of Chichen Itza in northern Yucatan and borrowed one of the gods of that city. Two examples of the famous Chacmool, or reclining god of Chichen Itza, have been recovered at Mercedes in Costa Rica. But the towns of the Chorotegas disappeared from the eastern portion of their old territory two or three centuries before the coming of the Spaniards, swept away, perhaps, by the unseen forces of disease.

After the virtual abandonment of this vast territory by early American nations that had reached the civilized plane, a much more primitive population pressed in from the south and built scattering villages along the rivers and the coast. These tribes may have had an earlier home in the forested regions of South America; they were the wild folk found by Columbus in northern Honduras and eastern Nicaragua, quite ignorant of clothing and the higher arts, living mostly by fishing and hunting.

The Spaniards preferred the sunny deserts to the rainy forests, and while they tried to maintain a convenient port here and there and to establish mission churches at which the Indians could be concentrated and put to profitable labor, they made no effort to regain the natural wealth by a systematic control of the difficult environment. Wild crops were gathered, including mahogany, campeachy wood for dye, rubber, and sarsaparilla. Some of the richest land in the New World still supplies only wild crops.

The banana, as we have seen, is not one of the

Stela K. The dwarfed figure is a male priest. The date is September 24, 545 A.D.

Stela F. A lofty monument dedicated on May 18, 501 A.D.

MAYAN MONUMENTS AT QUIRIGUA, GUATEMALA

Altar B. A boulder altar dated February 2, 521 A.D. It probably was a native offering to the planet Venus

Altar P. A great richly carved altar dedicated on November 16, 535 A.D., to the Planet Venus. It represents the 'Venus Monster'

MAYAN ALTARS AT QUIRIGUA, GUATEMALA

numerous plants of great economic value domesticated by the Indians of Central America. It came originally from another area of wet-land civilizations in southern Asia, and was introduced into the New World very soon after the Spanish conquest.

The commercial banana in Northern markets, however, is a matter of recent history. The United Fruit Company, a consolidation of several pioneer companies with brief experience, was organized less than thirty years ago. Its banana plantations are located in Central America, Colombia, and Jamaica. Especially in northern Honduras, first at Tela and next at Trujillo, great stretches of uninhabited forests have been traversed by railroads, swamps have been drained, plantations laid out, and huge port works constructed. These two districts are being rapidly developed and within a short time will be the greatest banana-producing centre in the world.

Archæological indications of a previous conquest of the forest by ancient Indian nations were found on the earliest farms of the United Fruit Company. At Mercedes, a farm on the 'Old Line' in Costa Rica, a rich archæological collection was made by Minor C. Keith, one of the founders of the Company. The mounds at Mercedes contained sculptures of crocodiles, monkeys, birds, and men, in addition to richly decorated pottery and some beautiful examples of gold work. Mr. Keith's collection is now in the American Museum of Natural History. It offers clear evidence of the everyday life, the arts

and even the aspirations of the ancient Chorotegas.

In Guatemala a fine banana farm encircles the ruins of Quirigua, famous for its giant statues representing priests or kings carrying ceremonial objects. Modern development of other parts of the Mayan area, such as the Usumacinta Valley, has been held back by the political conditions in Mexico.

The Ulua Valley, tributary to the port of Tela, is old Mayan territory and contains many groups of mounds. In the Trujillo district ancient village sites are common, some showing evidence of ancient ditches and palisades for protection. Ceremonial sites at which grinding-stones, great and small, were offered, as well as decorated stone bowls, have been opened up by recent exploration.

Sanitation Triumphs

In Cuba in 1898, Dr. Walter Reed and his companions, Carroll and Lazear, solved the yellow-fever problem. When the United Fruit Company was incorporated, in March, 1899, the way to meet and eventually overcome endemic and epidemic diseases had been pointed out. The road to commercial success, closed for centuries by the unhealthful, insanitary conditions in the lowlands of the countries bordering the Caribbean Sea, was open.

In Havana, Gorgas and Wood had tested the new plan of sanitation, based on fighting the germ-carrying mosquito, and proved it sound. Later, in 1904,

BEFORE SANITATION

AFTER SANITATION

A TROPICAL DIVISION OFFICE BUILDING

A BANANA OVERSEER'S HOUSE

Gorgas put these plans in operation on a grander scale at Panama in the work for sanitation which made the Canal possible. Meanwhile, the physicians of the United Fruit Company at Bocas del Toro, Panama, and later at Port Limon, Costa Rica, were carrying out the measures inaugurated by Reed and his colleagues, to whom, in his first official report, the Medical Director of the Company paid the following tribute:

> The Company here extends its homage to Dr. Walter Reed and his corps of heroes, who furnished the World, and indirectly our Company, with a few simple facts relative to the transmission of Yellow Fever. . . . The battle was fought in this Division, and so positive the result, so convincing the experiment, that these tried-out measures have been extended to all tropical developments of the Company.

Thus, from the beginning the United Fruit Company realized the necessity of combating insanitary conditions in the tropics, and for more than a quarter of a century has carried forward a relentless warfare against disease. The record of industrial progress in the tropics is really the record of medical and sanitary progress, for agricultural development and commercial activity on a large scale were impossible until medical science brought tropical disease under control, and sanitation transformed pestilential areas into healthful localities.

The commercial success of the Company is largely due to its accomplishments in reducing the prevalence of those diseases formerly responsible for an

appalling morbidity and high mortality. Yellow fever and smallpox as serious menaces have been eliminated, and the incidence of other fatal or debilitating diseases has been greatly reduced. While malaria and hookworm are still problems of considerable importance, progress is being made from year to year, and the localities where the Company operates now show health records which compare favorably with those of communities in the temperate zone.

Some idea of the extent and scope of the activities of the Medical Department may be gained when it is stated that the plantations of the United Fruit Company cover about 2,000,000 acres of tropical land in widely separated localities.

This area may be appreciated when we consider that the Company owns and leases approximately 3000 square miles of territory, whereas the State of Rhode Island contains about 1250 square miles, Delaware about 2400 square miles, and the Panama Canal Zone less than 500 square miles.

It is economically impracticable to sanitate all the areas contained in the Company's plantations, but strenuous efforts are made to keep all lands in the vicinity of dwellings in a sanitary condition, and mosquito-breeding places which cannot be eliminated by filling or draining are larvacided regularly.

In the centres of population and about individual dwellings, modern sanitary conveniences have been installed; the quarters of employees are modern and are under constant supervision.

A TROPICAL DIVISION HOSPITAL
Upper: Exterior. Lower: Hospital Ward

Gymnastics in school yard

Children on their way to school

A girls' class

SCHOOL IN A TROPICAL DIVISION

The Company has created an extensive system of hospitals and dispensaries for the benefit of employees and their dependents, as well as for other inhabitants in or adjacent to the plantations. Hospital service was first inaugurated by the Company in August, 1899, at Bocas del Toro, Panama, and a permanent hospital was opened there in January, 1901. In Costa Rica the Company operated two small hospitals as early as 1901.

It is estimated that, including both employees and non-employees, 150,000 persons are dependent upon the Medical Department for medical and surgical service, and a still larger number enjoy benefits from its sanitary and preventive work. It operates eight large modern hospitals with various dispensaries, located at convenient points on the plantations.

It will readily be seen that the work of the Medical Department is both varied and extensive. It offers unusual opportunities for the study of tropical problems and the investigation of rare diseases and exotic infections. Scientific workers are welcome.

The experience of this department was brought to the attention of the world at an international conference on health problems in tropical America, held at Kingston, Jamaica, in July, 1924, to which eminent and active workers representing all phases of medical and sanitary sciences connected with medicine, came from the four quarters of the globe as guests of the United Fruit Company. Delegates

were invited to represent universities, medical societies, health organizations, and governments. Following the scientific sessions at the Company's hotel at Kingston, Jamaica, the members of the conference were given an opportunity to inspect the medical and sanitary work of the United Fruit Company in its Central American divisions. The proceedings of this round-table gathering of experts have been published and distributed gratis by the Company to the medical world.

The welfare work of the Company in the tropics has assumed large proportions and has a direct bearing on the health and contentment of the employees. The Company has built and maintains churches and schools to meet denominational and racial requirements, and has erected and equipped clubhouses and amusement-halls to provide entertainment for employees. It has also provided baseball grounds and tennis courts, and in some plantations where it is practicable, golf grounds and swimming-pools. It operates extensive merchandise departments for the convenience of the local communities, and has also installed and maintains hotels, laundries, ice plants, bakeries, electric-light plants, water-works, and sewerage systems, transforming the zone of its tropical operations into modern, sanitary, and healthful areas.

Radio Telegraph

Second in importance only to sanitation in the development of the Central American countries

is the establishment of communication and transportation.

In erecting radio stations at Bocas del Toro, Panama, and at Port Limon, Costa Rica, and inaugurating the service between these two points early in 1904, the United Fruit Company established the first radio communication in either Central or South America. To-day, through its subsidiary, the Tropical Radio Telegraph Company, it maintains powerful radio telegraph stations at various points in the American tropics and in the United States, which are not only an important adjunct to the Company's business, but serve the general public as well.

The Company, utilizing these facilities, maintains a free radio-medical consulting service so that merchant ships can secure medical advice from the Company's hospitals or from its steamships carrying physicians. This service is widely used and has been a factor in ameliorating suffering and saving human life at sea.

This chain of radio stations also renders important service in the gathering and disseminating of storm warnings, which is of incalculable value to shipping in the Gulf of Mexico and the Caribbean Sea, as well as to the islands of the West Indies and the southern section of the United States.

The development of this radio system is the history of the development of radio communication between the Americas. The communication requirements of the banana industry, shortly after the

United Fruit Company came into being, were such as to offer every incentive to inventors and scientific investigators to improve the equipment and overcome static, the bugbear of all radio. In this work the United Fruit Company has been in the van in adopting improvements and contributing to the general scientific development of radio communication.

United Fruit Company

The United Fruit Company is engaged primarily in the production and transportation of tropical products, principally bananas, sugar, cacao, pineapples, and coconuts. It furnishes about half the bananas consumed in the United States. A large part of this fruit is purchased by the Company from outside planters.

Its selling subsidiary in the United States and Canada is the Fruit Dispatch Company with fifty-four branches.

Its English subsidiary, Elders and Fyffes, Ltd., maintains numerous branches throughout Great Britain and on the Continent, and a tropical producing division in the Canary Islands.

The United Fruit Company is not only the biggest farmer in the world, but also one of the largest factors in ocean transportation. It operates a fleet of one hundred steamships, including its chartered vessels, and those of Elders and Fyffes, Ltd. All its steamships are specially built and designed for tropical service, and equipped with radio. These steamships furnish regular passenger, mail, and

freight service between the Atlantic and Gulf ports of the United States and Cuba, Jamaica, Central American countries, and Colombia. The Company maintains in Jamaica two of the most modern hotels in the tropics, the Myrtle Bank Hotel at Kingston and the Hotel Titchfield at Port Antonio. This vast organization to-day employs about 70,000 persons.

Its tropical divisions are located in Cuba, Jamaica, Guatemala, Honduras, Costa Rica, Panama, and Colombia. In these countries it operates 1540 miles of railways and 1717 miles of tramways, as well as 3500 miles of telephone and telegraph lines. It owns 30,000 head of cattle and 11,500 horses and mules.

In Cuba it owns extensive cane-fields and two large raw-sugar mills, the product of which is refined and distributed by its subsidiary, the Revere Sugar Refinery, at Boston.

The Company carries on a large amount of agricultural research work and has completed and compiled, in comparative form, definite soil analyses of all its plantations, this work constituting what is probably the most extensive soil investigation ever undertaken by any commercial organization.

Its officials are men who have started at the bottom of the ladder. It is the fixed policy of the Company to have its representatives speak the language of the country in which they are working and to support all that is best in the social and economic life of those countries.

Non-political in its aims, the influence of the United Fruit Company is exemplified in all branches of communication and in the advancement of knowledge of sanitation, agriculture, and industry. The record of its achievements ranks with the best constructive work of those early pioneers, the East India and Hudson's Bay Companies. Other banana companies have followed the example of the United Fruit Company, and have done their share in sanitation and commercial development.

Economic Significance of the Banana Industry

The history of the banana trade is one of the romances of business. From small beginnings, hardly more than a generation ago, it has developed into an industry of great size and large importance, which is a potent factor in the commercial life of the countries producing and exporting the fruit. Moreover, it is comprehensive in its economic aspects, since it involves a highly specialized system of production in widely separated and extensive tropical territories, and the maintenance of adequate and carefully controlled means of rail and water transportation.

There can be no greater evidence of the economic value of the banana than the fact that it has justified the devotion of so much scientific skill to solving the problems connected with its cultivation in the tropics and its transportation to world-wide markets.

It is an outstanding fact that the banana has helped in a better understanding of and relations

with the Central American republics. With improved sanitary conditions, increased employment, a more stabilized currency, and an efficient and constant steamship and radio service, these countries are taking their place among the prosperous and important food-producing regions of the world.

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THIS bibliography embraces a list of authors and titles referred to in the foregoing pages, as well as other works of value to which no reference is made in the text. For the convenience of the reader, this material has been grouped as follows: *I. General*, including literature in which general reference is made to the banana; *II. Botany and History*, including texts to which reference is made definitely under these subjects; *III. Chemistry and Food Value*, a collection principally, but not wholly, of technical literature on analyses and dietary uses of the banana. Titles of books and periodicals are in italics and titles of articles are in quotation marks.

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